

Handbook of Social Interactions in the 21st Century

Anne T. Heatherton
Vivian A. Walcott
NOVA
Editors

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IN THE 21ST CENTURY**

**ANNE T. HEATHERTON
AND
VIVIAN A. WALCOTT
EDITORS**

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PREFACE

Social interaction is a dynamic, changing sequence of social actions between individuals (or groups) who modify their actions and reactions according to those of their interaction partner(s). In other words, they are events in which people attach meaning to a situation, interpret what others are meaning, and respond accordingly. Social interactions can be differentiated into: Accidental (also known as social contact) - not planned and likely not repeated. For example, asking a stranger for directions or shopkeeper for product availability. Repeated - not planned, bound to happen from time to time. For example, accidentally meeting a neighbor when walking on your street; Regular - not planned, but very common, likely to raise questions when missed. Meeting a doorman or a security guard every workday in your workplace, dining every day in the same restaurant, etc. Regulated - planned and regulated by customs or law, will definitely raise questions when missed. Interaction in a workplace (coming to work, staff meetings, playing a game, etc.), family, etc. In sociological hierarchy, social interaction is more advanced than behavior, action, social behavior, social action and social contact, and is in turn followed by more advanced concept of social relation. In other words, social interactions, which consist of social actions, form the basis for social relations. This new handbook presents the latest international research in the field.

Chapter 1 - Suggesting that immune responses could be influenced by psychosocial factors was quite controversial just a couple of decades ago, but the clear demonstration of this relationship made it a commonplace and a core process in health psychology. However, the recent developments in Psychoneuroimmunology emphasize the importance of the reverse process, i.e. the influences of the immune system over the social interactions. In the past decade, the behavioural influence of the active immune system has been clearly established through the action of cytokines on the brain. Such behavioural changes (e.g. decreased general activity, curled-up posture, hypophagia) have been related to the onset of a specific motivational state devoted to support recovery processes. However, if social behaviours have received a limited attention, some recent advances reveal some noteworthy relations between immunity and sociality. But despite the many benefits offered by sociality (e.g. food sharing, increase defensive capacities against predators or other threats), one of its main drawbacks is the increased propensity to be exposed to parasites and pathogens. And the more social interactions are intense, the more each social partner is “at risk”. Such a potential menace of contamination questions the adaptive functions of sociality and calls for further investigations.

The immune-induced changes in social interactions can be considered at two different levels: the level of the immune-activated individual, and the level of the healthy social mates. The present chapter will focus on recent development on immune-related social changes, at both individual and group levels. The first part will present progresses in the understanding of the influence of immunity on the social behaviours displayed by immune-challenged individuals, particularly in relation to changes in their emotional reactivity to social stimuli. A second part will examine the changes in the social behaviours of healthy individuals in response to the exposure to an immune-challenged social partner (e.g. pathogen avoidance strategies). The data will be presented in a comparative perspective and will encompass works on both vertebrates and invertebrates. This comparative approach allows to address the question of the evolutionary roots of this immune-related behavioural changes, and more particularly on the place of the immune system from the construction of the self and the evolution of sociality.

Chapter 2 - In a free society, Julian Simon argues, increased population and income cause short-run resource scarcity that induces innovation, which leaves us better off than if the shortage problem had not arisen. Simon points out the importance of freedom from government coercion, and substantiates his argument of the innovative capability of free societies to overcome resource scarcities by empirical evidence, but he does not explore the social interactions behind his ultimate resource – human imagination acting together with educated skills in a free society – that is what economic personalism calls creative subjectivity of the human person. Culture provides the morality of social interaction in market, civil society, and state. Using Adam Smith's notion of fellow-feeling to describe sympathy, morality is a complex order that emerges through social interaction. Reciprocity is crucial to human cooperation and culture may include norms that create reciprocal sympathy. Cultural norms that yield reciprocal sympathy constitute social capital. This chapter argues that it is necessary to study the cultural foundations of a free society in order to understand why solutions to resource shortages are eventually found in such a society. Within the context of a correlated evolutionary Innovative Exchange game, market, civic, and political entrepreneurs are innovative agents, who interact through various combinations of exchange, integration, and threat, possibly establishing a price signaling system that makes them take the appropriate innovative action. Innovative exchange is an evolutionary process, because bounded rationality, genuine uncertainty, and rule following characterize innovation, while correlation gives some degree of non-anonymous interaction, thus facilitating coordination. The innovative agents create heterogeneous capital combinations, which form the capital structure of the economy. The purpose is to study how cultural differences in reciprocal sympathy between Lithuania and Sweden influence the possibility of promoting learning to overcome resource scarcities through economic integration within the Baltic Sea Area in the form of Baltic-Nordic learning networks. This would require that Baltic and Nordic cultures yield the same level of reciprocal sympathy. The historical-anthropological-interpretive approach adopted in this chapter develops a genealogy of institutions, regarding culture as a shared unified field of consciousness, whose structure is given by a shared history, thus corresponding to a mental map. The shared unified field of consciousness in Lithuania and Sweden, respectively, will be studied from today's perspective through indicators of values and beliefs and then look backwards to find their respective historical origins.

Chapter 3 - Social interaction through the Internet is becoming commonplace today. Internet users may wish to work together across organisational boundaries and do so with

limited understanding of one another. Therefore, social relations appear to be more dynamic and volatile than the social interaction in an intranet. In order to achieve high efficient social interaction in the Internet, it is necessary to develop new techniques to support the Internet users. In this chapter, the social behaviour network (SoBeNet) is proposed to manage actions and reactions of agents in the Internet environment for social interaction. In the SoBeNet, an agent on behalf of an Internet user senses web document changes and acts or reacts accordingly for achieving its own missions or goals. Distributed agents then interact with each other in a common knowledge space to self-organise a virtual organisation. Each agent in the SoBeNet is composed of an ontology based virtual state space, a fuzzy logic based virtual sensor, a behaviour network driven virtual controller, and a belief model based virtual adaptive machine for interaction in dynamic and uncertain web-environments. A prototype of the SoBeNet built on JADE is developed by following the theory proposed in this chapter and a case study is carried out to illuminate the design methodology and validate the effectiveness of the SoBeNet in dealing with dynamics and uncertainties.

Chapter 4 - The recent technological advances and the exponential growth of the Internet have multiplied the opportunities for forming virtual relationships. Today, people can come together in the same virtual space or "cyberspace". They can communicate with their family or friends on-line, encounter new people through computer-mediated communication (CMC) and also learn or work in virtual groups. There is no doubt that a better understanding of how people use computers and communication technologies to work together and learn at a distance will be a major challenge for the coming years. Many terms have been used to describe the digital environments for collaboration in geographically dispersed teams such as CSCL (Computer-Supported Collaborative Learning), CSCW (Computer-Supported Cooperative Work) or CSGBL (Computer-Supported Group-Based Learning). The objective of the present chapter is to examine the functioning of virtual learning or working groups. First, the effect of reduced auditory and visual cues in CMC on collaboration between members of dispersed teams will be examined. These new digital environments are in fact supposed to facilitate collaboration at a distance allowing remote interactions between members of a group. However, some studies have also found some negative effects of distance in collaborative learning/working groups. After examining these different effects, some recommendations are made for improving the functioning of virtual groups.

Chapter 5 - Temperamental shyness is an early appearing, extreme form of shyness that is observed in approximately 5-10% of typically developing children. This form of shyness is associated with a pattern of heightened fearfulness and behavioral restraint in the face of both social and non-social forms of novelty and serves as a risk factor for the development of anxiety disorders later in life. Here the authors provide a brief overview of this temperamental style, with a special focus on its biological underpinnings and its expression across the lifespan. Our findings suggest that temperamentally shy individuals exhibit a distinct pattern of central and autonomic physiology that is associated with hypersensitive forebrain-limbic circuits. These differences in neurophysiology emerge during early post-natal life, are evident during resting conditions and in response to various social stressors, and appear to remain modestly stable throughout development, possibly pre-disposing individuals for further psychopathology. The authors also discuss the importance of dynamic interactions between genes and environments (both exogenous and endogenous) in the development of socio-affective systems and the utility of psychophysiological measures in helping us to bridge the gap among genes, brains and behaviors.

Chapter 6 - During recent decades, fear about terror acts has risen. This development was and is supported by the increasing vulnerability of industrial societies (e.g., due to nuclear power plants and terrorists' attacks, e.g., in the Far East or 9/11). These tendencies influenced not only political decisions but the course of everyday life as well. As those events are extreme and rare, the psychological consequences and processes involved are so far relatively unknown. The authors discuss a possible framework for explaining these new developments by feasible psychological theories. A suitable approach is the Cumulative Prospect Theory (CPT) by Tversky and Kahneman (1992). According to CPT, rationality is defined in respect to subjective reference points rather than to general objective criteria. The possibilities of explaining and predicting different definitions of rationality by means of CPT are discussed. Other features of CPT relevant in this context are cognitive illusions like the representative heuristic and availability heuristic. These heuristics cause a subjective representation of events that is not appropriate according to rational criteria. Therefore, such biases explain why terror events appear to be a real harassment in everyday life even though they are statistically less likely to occur than other incidents (e.g., traffic accidents). The authors also discuss the possibility of explaining the psychological processing of information dealing with terror threats by other phenomena known in the psychology of heuristics, biases and errors that are not explicitly addressed in CPT. These are the so-called validity, misinformation and labeling effects, illusionary correlations and the peculiarities involved when flashbulb memories are processed. Finally, the subject area of the psychology of suggestion will be addressed as a possible framework for these theories, heuristics and effects.

Chapter 7 - Supportive social interactions are believed to be important moderators of the phenomenological experience of stress, and so to benefit individuals by ameliorating negative outcomes. This valorization of social support as universally beneficial to humanity has stimulated an overwhelming research literature in health psychology, which emphasizes several inverse statistical associations between social support and physical disease. As this focus resonates with widely-held cultural assumptions about altruism, the health-positive reputation of social cohesion and mutual supportiveness appears at times to be virtually indisputable.

Guided by this worldview, scientific attention has focused on exploring precisely how socially supportive relationships exert positive impacts. However, despite copious research, several particular aspects of the construct and ecology of social support have been neglected in health psychology literature. As well as lacking a specific definition of "social support", health-focused research has conspicuously failed to link with the wider social psychology literature and the important paradigms it offers. Individual differences in how recipients might interpret and respond to offers of support are also under-researched. Empirically, health-focused research on social support relies heavily on cross-sectional or laboratory paradigms, which threaten internal and external validity.

The authors argue that the fundamentally atheoretical nature of health psychology research on socially supportive interactions and relationships weakens its explanatory power. The authors argue for greater theoretical sophistication in these investigations, and show how the integration of such research with the wider social psychology literature offers a superior set of paradigms within which the undoubtedly important impact of social interactions on health can be explicated.

Chapter 8 - Social aggregations of fish, termed shoals, are demonstrated by many species and provide individuals with a number of benefits including enhanced access to food and

mates, and increased protection from predators. For shoaling fish to reduce predation risk they must choose to aggregate with phenotypically similar fish. In a phenomenon, referred to as the 'confusion effect,' predators have difficulty singling out a specific individual amongst a shoal of similar fish and hesitate momentarily, increasing the opportunity of escape by fish in the shoal. In a related phenomenon known as the 'oddity effect,' phenotypically distinct individuals within a shoal are more likely to be targeted by a predator. It is, therefore, not surprising that fish appear to identify specific phenotypic characteristics and actively choose to associate with fish bearing physical traits similar to their own. Shoal mate choice is also affected by experience. In a series of studies, fish demonstrated shoaling preferences for fish similar to those with whom they had been reared even when those choices would violate the basic premises of the confusion effect. Such results show the effects of learning on shoaling behavior.

In this chapter the authors provide a review of literature pertaining to shoaling behavior in fish. This review includes analyses of the benefits and costs of shoaling along with an examination of the effects of gender, body size, body coloration, body pattern, familiarity, shoal size, parasite load, and species composition on shoal mate choice. The authors also review current literature on the effects of experience on shoaling choices and provide a new, previously unpublished study detailing the interplay between body coloration, shoal size, and body size on shoaling behavior.

Chapter 9 - The presence of social allies may buffer adverse consequences of social stress. This has mainly been demonstrated in mammals and recently also in birds. The behaviour of social allies might crucially influence to which extent social context may buffer the behavioural and hormonal response to stress. The authors here examined the influence of social context on the hormonal response to handling stress in great tits (*Parus major*) selected for fast and slow exploration. The authors tested 16 male-female pairs (8 fast-fast pairs, 8 slow-slow pairs) after the breeding season. The authors subjected females to handling stress and thereafter observed their behaviour and collected droppings for the following 2½h with their mate being either absent or present when the females came back into her home cage. As control the same females were not handled prior to observation and their mate was present. In addition, the authors tested 7 fast and 7 slow unpaired females in the conditions control and mate absent. The authors measured immunoreactive corticosterone metabolites (CM) in droppings using an enzyme immunoassay. Fast females excreted significantly higher CM mean values when they were alone after handling stress (mate absent) than in the control condition and in condition mate present. Slow females tended to show a similar pattern. While fast females increased their locomotory activity, slow females sat close to their mates longer after handling stress compared to control days. Pair mates resting and feeding synchronously excreted lower CM than asynchronous pairs, irrespective of their behavioural phenotype. Paired and unpaired females did neither differ in behavioural nor in hormonal stress response, indicating that observed differences between condition mate absent and mate present in paired females were not due to an accumulation of stressors (mate absent plus handling) in condition mate absent. The authors here show for the first time, that depending on behavioural phenotype birds increased social proximity after a stressful event and that pair synchrony may modulate corticosterone excretion.

Chapter 10 - Early studies on determinants of social interactions among animals typically focused on the influence of factors such as age, sex, physical attributes, group size or environment. Variation within categories of these factors was often regarded as uninteresting

‘noise’. However, during the past two decades individual variation in behaviour within populations has received increasing attention from researchers. Consistent individual differences in behaviour expressed by personality traits have been studied both from mechanistic and functional perspectives in several animal taxa and have been shown to affect fitness. Personality is also shaped by the social and non-social environment. In group-living species, an individual’s behaviour and the choices it makes are influenced by the behaviour and choices of group members. Social learning is one such form of influence, which can modulate the patterns of social interactions and relationships within a group.

Personality traits and social learning have been reported to affect social and non-social behaviour (e.g. foraging, exploratory behaviour, dominance, aggression, mate choice) in several animal species. However, research on the influence of animal personality and social learning on the several dimensions of social behaviour is still warranted and the authors believe it would shed new light on the development of social relationships. Therefore, the authors discuss previous research and suggest future directions for the study of the influence of personality and social learning on social interactions among nonhuman animals.

Chapter 11 - Inclusion of students with disabilities in the ordinary school is one of the most powerful trends in contemporary special education worldwide; its success depends on a number of factors, such as social skills that constitute the focus of the specific chapter. Research indicates that students with disabilities often experience deficits in acquiring and using the necessary social skills to create and sustain positive interpersonal interactions. Social skills interventions can be delivered by students with disabilities themselves, by adult tutors or by peers; the contribution of the latter to the development of social skills will be further explored. Structured interactions with non-disabled peers are considered an effective approach to supporting students with disabilities learn and practice social skills needed for successful inclusion in the school, the community, and the workplace. The aim of this review is to extrapolate the best practices and to identify the major advantages and disadvantages of interventions based on peer tutoring. In order to familiarize the reader with the conceptual framework that the authors use, the chapter will begin with a consensus on the definition of social skills and an overview of the methods of their assessment. This will be followed by a review of peer-mediated interventions aiming at enhancing the social skills of students with various disabilities, such as autism spectrum disorders, behavioral problems, and learning disabilities, which constitute the main focus groups of published research. The chapter will conclude with a critical interpretation of the outcomes of peer-mediated social skills interventions for students with disabilities.

Chapter 12 - This study examined the effects of classwide peer tutoring (CWPT) on social interactions of children who are English language learners and children whose native language is English. Seven English language learners and 7 native English speakers from two second-grade classrooms were selected as the participants. Children’s social interactions were operationally defined as 15 social behaviors according to the social interaction observation system (SIOS). These behaviors were further divided into seven positive behaviors, five passive behaviors, and three negative behaviors. Baseline data were collected during the free play time immediately after the 20 minutes of teacher instruction on a specific academic content. In intervention, data were also collected during free-play time, but immediately after the 20-minute CWPT procedure. A single-subject withdrawal design (ABA) was applied, with Phase A the baseline condition and Phase B the intervention (CWPT) condition. All the seven positive behaviors were substantially increased during the CWPT condition and

decreased during the baseline condition. A substantial difference was found between the two groups during intervention. The Teacher/Student Satisfaction Questionnaires showed positive responses from participating teachers and students.

Chapter 13 - As a result of the financial demise of several international corporations in recent years, the need for competent internal audits has received significant attention. Although most corporations conduct internal audits, their effectiveness has often been suspect and many of the existing instruments with which to measure internal audit effectiveness have severe limitations. Development of the new instrument to quantitatively measure the effectiveness of internal audit functions is clearly needed. This study uses the Internal Audit Professional Practice Framework to examine the validity and reliability of a new instrument with which to conduct internal audits. The results suggest that the instrument is highly reliable and conforms to the standards established by the Institute of Internal Auditors -- the professional organization governing the internal auditing profession.

Chapter 14 - Sociotropy and autonomy are conceptualized as two personality dimensions that relate to an individual's vulnerability to depression (Beck, 1987). Sociotropy is characterized as an excessive investment in interpersonal relationships and autonomy is characterized as an excessive concern with personal achievement and control over the environment. The present research project consisted of two studies examining the relationships between sociotropy-autonomy and interpersonal patterns in close relationships. The purpose of Study 1 was to examine the interpersonal problems that sociotropic and autonomous individuals tend to experience with close others using self-report questionnaires. The goal of Study 2 was to move beyond the method of self-report questionnaires and to actually observe the interpersonal behaviors of individuals with varying levels of sociotropy and autonomy. The findings of both studies suggested that highly sociotropic individuals display more behaviors that are low in affiliation and high in dominance than individuals low in sociotropy. Furthermore the results also suggested that highly autonomous individuals display more behaviors that are low in affiliation and low in dominance than individuals low in autonomy. These findings will be discussed in the context of the literature regarding the interpersonal characteristics of sociotropic and autonomous individuals.

Chapter 15 - This paper explores the development of a conception of social interactions as contingent exchanges in which social partners participate in bidirectional influence. Research on children's understanding of the causes and consequences of social acts, children's ability to consider contrasting perspectives on the same social event, and children's second-order mental state reasoning is reviewed. These concepts and abilities may provide a foundation for a transition from understanding social acts to understanding social interaction. Possible developmental patterns are discussed and directions for research are identified.

Chapter 16 - Social Dominance theory (Sidanius, and Pratto, 1999) posit that all human societies are organised in group-based hierarchical systems. Group-based hierarchy often produces discrimination and domination. Social Dominance Orientation (SDO) is considered a personality variable that measures a general individual orientation to accept hierarchy, and consequently to justify discrimination and domination between groups, within any given social system.

In modern Western Countries societies, SDO can influence attitudes towards immigrants also in respect of their acceptance or refusal as new citizens. The meanings that people attribute to citizenship lie on specific conceptions about the nature of social contract between the individuals and the State. This one can be perceived as a champion of the defence of

ingroup (citizens) privileges against the challenging outgroup (settled immigrants), or a social entity based on participation and solidarity towards the weaker social categories that compose it, including settled immigrants.

The study involved 239 adult Italians (average age = 45.51; S.D. =15.03). The basic hypothesis, tested via structural equation model, was that SDO influences conception of the nature and tasks of the State, and attitudes toward multiculturalism (acceptance vs. refusal of cultural differences) that, in turn, influence majority members attitudes towards the inclusion of settled immigrants in the ingroup. This last variable was operationalized by means of the agreement to grant to immigrants the right to vote in general elections.

As expected, results showed that SDO influences a negative attitude towards multiculturalism and a penal State concept. This conception of the State influences the agreement with concession of the right to vote to legal immigrants but, contrary to our first hypothesis, attitude toward multiculturalism do not.

Chapter 17 - The Japan Professional Baseball League recently began interleague play, in which the Central league teams play a game with the Pacific league teams, in order to attract fan interest. The Central League is far more popular than the Pacific League. This paper explores whether the different features of the two leagues eventually result in affecting the demand behavior of fans for interleague games. The main findings are that when compared with the PL fans, the attendance of the CL fans tends to be more inelastic with respect to team performance and competitive balance but more elastic with respect to ticket prices and the existence of substitutes. Social interaction and addictive behavior appear to account for the evidence, as stated above.

Chapter 18 - The authors explored the impact gender, alcoholic drink type, and amount drank had on perceptions of sexual intent. An experiment was conducted in which participants watched a video of a female target and her date socializing at an after-finals party. The type of alcoholic drink (beer or margarita-flavored alcopop) and amount drank (two or six drinks) was fully crossed. As hypothesized, men rated the female target in more sexual terms than did women. In addition, alcohol cues impacted perceptions of the female target as women rated the female target as more promiscuous when she drank six margarita-flavored alcopops versus two.

Short Communication - Recently, social capital has been considered as a production factor along with physical capital and human capital, that contribute to higher economic growth and also improve economic productivity. Social capital is also considered important for the efficient performance of modern economies and the *sine qua non* of a stable liberal democracy. It constitutes a component culture of societies that has been organized from both informal and formal institutions and legal norms and rationality.

Therefore, social capital is a concept that refers to social networks and reciprocity norms associated with them and are the same as physical capital and human capital, wealth creation, as much individual as collective.

This conception does not imply that the creation of norms generates in itself social capital, but rather these should lead to cooperation between groups and, therefore, they are related with virtues like honesty, commitments maintenance, duties maintenance and reciprocity. From this point their connection is clearly deduced from the socio-economic profitability of the ethics, also, as certain moral behaviour causes an increase in social capital in certain countries that influence positively on their economic growth and on their economic productivity.

This conception of social capital and its economic function, surprise the traditional economic analysis, where the objective of the individuals is to get the maximum possible benefit that can be generated by individualist and egoist morals. So, this paper analyses the essential components of social capital, norms and shared values, reciprocity, trust, honesty, and social networks and their economic effects. After this theoretical analysis, empirical evidence from forty-three countries will be analysed.

Expert Commentary - Disturbances of social interaction in people suffering from major psychiatric illnesses have attracted concerns from clinicians, researchers, and healthcare administrators, as these deficits are a major determinant of outcome for patients. Impaired social abilities in schizophrenia-spectrum disorders and autism are thought to be partly attributable to specific aspects of symptomatology, such as negative symptoms (blunt affect, social withdrawal, anhedonia) and disturbances of several domains of cognitive function, e.g. verbal memory, working memory, attention/vigilance, and information processing. The authors recently found that severity of social cognition deficits is correlated with decreased concentrations of essential polyunsaturated fatty acids in the erythrocyte membrane in subjects with schizophrenia.

Psychotropic drugs acting on monoamine receptors, such as serotonin (5-HT)-5HT_{1A}, and 5-HT_{2A} receptors, have been shown to improve social behavior and cognitive function in rodents. For example, 5HT_{1A} agonists enhance social interaction and reduce anxiety in rodents, while the newer class antipsychotic drugs with 5-HT_{2A} antagonist actions, e.g. clozapine, melperone, olanzapine, risperidone, quetiapine, ziprasidone, aripiprazole, and perospirone improve negative symptoms and social cognition.

Several lines of recent research indicate some neuropeptides, such as arginine-vasopressin (AVP) and oxytocin, regulate social interaction in mammalian species, including humans. The authors have reported that NC-1900, an AVP analogue and agonist at AVP-V1a receptors, ameliorates social interaction deficits in rats treated with MK-801, an antagonist at N-methyl-D-aspartate (NMDA) receptors. This result from an animal model of schizophrenia is consistent with our earlier observation that chronic administration of the NMDA antagonist phencyclidine reduces the V1a receptor number in some brain regions in rats showing social interaction deficits.

These findings warrant further research into the serotonergic and neuropeptidergic system, or the interaction of the above, to facilitate the development of therapeutic tools to target disturbances of social interaction in patients with schizophrenia or other psychiatric disorders.

Chapter 1

IMMUNITY, HEALTH AND SOCIALITY: IMMUNE-RELATED CHANGES IN SOCIAL INTERACTIONS

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ABSTRACT

Suggesting that immune responses could be influenced by psychosocial factors was quite controversial just a couple of decades ago, but the clear demonstration of this relationship made it a commonplace and a core process in health psychology. However, the recent developments in Psychoneuroimmunology emphasize the importance of the reverse process, i.e. the influences of the immune system over the social interactions. In the past decade, the behavioural influence of the active immune system has been clearly established through the action of cytokines on the brain. Such behavioural changes (e.g. decreased general activity, curled-up posture, hypophagia) have been related to the onset of a specific motivational state devoted to support recovery processes. However, if social behaviours have received a limited attention, some recent advances reveal some noteworthy relations between immunity and sociality. But despite the many benefits offered by sociality (e.g. food sharing, increase defensive capacities against predators or other threats), one of its main drawbacks is the increased propensity to be exposed to parasites and pathogens. And the more social interactions are intense, the more each social partner is “at risk”. Such a potential menace of contamination questions the adaptive functions of sociality and calls for further investigations.

The immune-induced changes in social interactions can be considered at two different levels: the level of the immune-activated individual, and the level of the healthy social mates. The present chapter will focus on recent development on immune-related social changes, at both individual and group levels. The first part will present progresses in the understanding of the influence of immunity on the social behaviours displayed by immune-challenged individuals, particularly in relation to changes in their emotional reactivity to social stimuli. A second part will examine the changes in the social

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behaviours of healthy individuals in response to the exposure to an immune-challenged social partner (e.g. pathogen avoidance strategies). The data will be presented in a comparative perspective and will encompass works on both vertebrates and invertebrates. This comparative approach allows to address the question of the evolutionary roots of this immune-related behavioural changes, and more particularly on the place of the immune system from the construction of the self and the evolution of sociality.

INTRODUCTION

Animals, including humans, have always lived surrounded by pathogenic microorganisms (viruses and bacteria) and will continue to do so. Animals acutely sick from systemic protozoan, bacterial or viral infections, commonly display a whole set of non-specific symptoms. Among the most reliable symptoms are fever, sleepiness, uneasiness, reduced sexual activity, reduced exploration and reduction in food and water intake (Hart, 1998, Dantzer et al., 1996; Aubert, 1999). These common symptoms of inflammation are mainly dependant on the release of pro-inflammatory cytokines such as interleukine-1 β (IL-1 β) synthesized both centrally and peripherally (Dantzer, 2001), and their influence on the brain. Moreover, these behavioural symptoms of sickness have been well described by many authors, and “sickness behaviour” (Aubert, 1999; Kent et al., 1992; Dantzer, 2001) is now considered as a motivational state competing with other motivated activities such as foraging, feeding, or mating (Aubert, 1999; Aubert et al., 1997a; Aubert et al., 1997b; Renault and Aubert, 2006). In that way, the physiological and behavioural modifications induced by the activation of the innate immunity is commonly viewed as an adaptive way to promote recovery from an infection (Hart, 1988; Aubert, 1999; Dantzer, 2001).

If social behaviours have received a limited attention so far, among the nonspecific symptoms of inflammation, a loss of interest in social environment is nevertheless commonly described (Dantzer et al., 1996). One putative function would be to limit the risk of infection of the other members of the social group (Hart, 1990). Indeed, despite the many benefits offered by sociality (e.g. food sharing, increase defensive capacities against predators or other threats), one of its main drawbacks is the increased propensity to be exposed to parasites and pathogens. And the more social interactions are intense, the more each social partner is “at risk”. Such a potential menace of contamination questions the adaptive functions of sociality and calls for further investigations. This commonly cited behavioural feature is mainly based on experimental studies where an adult mouse or rat interacts with non-familiar juvenile conspecifics (Bluthe et al., 1992; Crestani et al., 1991; Fishkin and Winslow, 1997). In such a case, social investigation is lowered when the adult mouse is treated either with bacterial endotoxin (lipopolysaccharides, LPS: a potent cytokines inducer) or a pro-inflammatory cytokine such as IL-1. Hence, the commonly reported social disinterest of cytokine-treated animals is based on a very specific experimental context (i.e. encounter with a juvenile animal). Moreover, a decrease in social exploration is quite different from an active isolation. Indeed, when studying the behaviour of sick animals, it is important to consider the motivational aspect that can modulate its expression. Regarding another social context such as maternal behaviour, it has been reported that bacterial endotoxin did not reduce pup retrieving in lactating mice while the expression of other non-social components of maternal behaviour (i.e. nest building) were dependent on external physical parameter (e.g. room

temperature) (Aubert et al., 1997a). The interpretation is that the expression of behaviour in LPS-treated mice depends of relative priorities, which are under the influence of both internal (physiological) and external (environmental) cues and differ from healthy individuals.

However, the immune-induced changes in social interactions can be considered at two different levels: the level of the immune-activated individual, and the level of the healthy social mates. The present chapter will focus on recent development on immune-related social changes, at both individual and group levels. The first part will present progresses in the understanding of the influence of immunity on the social behaviours displayed by immune-challenged individuals, particularly in relation to changes in their emotional reactivity to social stimuli. A second part will examine the changes in the social behaviours of healthy individuals in response to the exposure to an immune-challenged social partner (e.g. pathogen avoidance strategies). The data will be presented in a comparative perspective and will encompass works on both vertebrates and invertebrates, the later opening the way to further understand the evolutionary roots of these immune-related social changes.

CHANGES IN SOCIAL BEHAVIOR IN THE IMMUNE-CHALLENGED SUBJECTS

Immune-Induced Changes in Sexual Behaviour

Social stimuli can delay the expression of sickness behaviour. For example, among the various motivational systems that can compete with the expression of sickness behaviour (i.e. motivation to rest and recover), one of the most potent is the sexual motivation. The influence of an immune challenge on sexual behaviour has been commonly observed and discussed in term of parental investment according to the gender of the subject especially by Avitsur and Yirmiya in their seminal works on sexual behaviour in rats following an immune challenge. It was demonstrated that male rats injected with interleukin-1 β (IL-1 β , one of the main proinflammatory cytokines) still expressed active sexual behaviours as opposed to females who presented an inhibition for this type of behaviours (Yirmiya et al., 1995). For example, female rats injected with bacterial endotoxin (lipopolysaccharides or LPS: cell wall fragments from *Escherichia coli*, a potent cytokine inducer) or IL-1 β displayed less entreaties and sexual activity towards a sexually active male compared to controls (Yirmiya et al., 1995). On the other hand, LPS- or IL-1 β -treated males did not show any loss of sexual motivation, and sexual behaviours were expressed as readily as controls when confronted to healthy females (Avitsur et al., 1997). These results suggest that this decrease in sexual motivation can be considered as adaptive since female rats are exposed to an increased chance of mortality of their offspring (abnormal development, spontaneous abortion) when facing an infection during pregnancy (Silver et al., 1994; Zahl and Bjerknes, 1943), while males do not face such a risk.

Immune-Induced Changes in Maternal Behaviours

Other highly motivating social stimuli are provided by parental concerns. In a study by Aubert and colleagues (Aubert et al., 1997a), authors focused on some aspects of maternal behaviour expressed by lactating female mice and its ability to compete with the expression of sickness behaviour. In that study, it was demonstrated that female treated with bacterial endotoxin modified their nest building behaviours according to the external temperature of the home cage. Indeed, this experiment showed that LPS-treated mouse dams still express pup retrieving behaviour when environmental conditions are neutral (at a temperature of 22°C) while the nest building behaviour is nearly suppressed (both behaviours are expressed in control group). These two types of behaviours do not have the same adaptive value regarding the survival of the neonates because of their initial incapability to regulate their internal temperature. The retrieving behaviour remains compulsory for the survival of pups whereas the nest building serves the decrease of heat loss when the ambient temperature is too low. When the external temperature was changed and decreased to 6°C (in other words when the survival value of the nest was increased), the sick lactating female still expressed pup retrieving but also engaged in nest building. In that study, authors showed that the motivation to build a nest became stronger than the motivation to recover from infection when the pup survival was engaged. Authors concluded that this behavioural modification depends upon the priority in their expression after an evaluation of the subject. This result is in accordance with the motivational theory of sickness and, in that case, the behavioural modification was induced by external cues from the physical environment (Aubert et al., 1997a).

Another behavioural model to study the influence of sickness on maternal behaviour is the defence of the litter against a social threat, also called “nest-defence behaviour”. This behaviour is normally expressed by a lactating female when an unfamiliar male intruder is present in the nest proximity (Gandelman, 1972) and serves to prevent infanticide (Wolff, 1985). Infanticide is commonly expressed in a wide range of animal species and especially in rodents where maternal care is crucial for the survival of the offspring. Indeed, the presence of pups prevents the lactating female to be in oestrus and their suppression by another male is interpreted as a “strategy” to provoke a new fertile state quickly without “waiting” their weaning (Hrdy, 1979; Trivers, 1972). Contrary to the case of maternal care, the maternal aggression is mainly dependant of the threat by itself (i.e. the presence of the intruder male), and also on its intensity (i.e. the intensity of the social behaviours expressed by the intruder male). Indeed, the intensity of the social threat can be linked with the expression of 70 kHz ultrasonic vocalizations (USV) by the male during its interaction with the lactating female. This type of approach can lead to a better understanding of the behavioural reorganization that occurs during an immune challenge. Indeed, the possible dam’s behavioural modifications observed when an intruder male is placed in the home cage can also depend on the male’s changes in its own behaviour. The maternal nest-defence paradigm allows to study the effects of social cues on the motivational processes occurring during the expression of sickness behaviour contrary to the previous experiment described that allowed to study the influence of the physical environment. In a recent study, these maternal defensive behaviours against a social threat have been investigated in mice (Renault et al., 2007).

Results showed that LPS-treated females still expressed an efficient defence of their litter (i.e. the males were successfully kept away). Moreover, even if maternal nest-defence

behaviour is not suppressed, its dynamic of expression is quite different from controls because immune-challenged females express a lower quantity of agonistic behaviours than saline-treated animals. This reduction is the consequence of a decrease in the expression of offensive acts and postures towards the unfamiliar male whereas there is no decrease in defensive postures. This suggests that sick dams modify their strategy to protect their nest by lowering the expression of offensive behaviours towards the male without reduction in the defensive components. Nevertheless, this strategy seems sufficient to keep the male away from the nest area. In addition, the comparison in the dynamic of aggression showed that the proportion of both offensive and defensive components remains higher during the first minute of encounter with the unfamiliar male. In other words, immune-challenged mice displayed an earlier/precocious dynamic of aggression towards the intruder males. It can be hypothesized that this particular type of response displayed by LPS-treated females has a lower metabolic cost than the response displayed by controls and contributes to save energy for the infection recovery process. Indeed, sickness behaviour has been argued to be adaptive since it enhances the effectiveness of fever and saves energy for this purpose (Hart, 1988). This explanation also matches with the higher rate of agonistic behaviours expressed during the beginning of the encounter. Lactating mice modify their defensive strategy and express a shorter but stronger response during the first minute of the interaction leading to a kind of “proactive” strategy.

In a recent study, Weil et al. (Weil et al., 2006) investigated the effects of various dosage of LPS on maternal aggression against an intruder male and showed that this kind of behaviour is still expressed by LPS-treated mice. They linked their observations with an activation of the hypothalamic-pituitary-adrenal axis (HPA axis). In that study, authors injected various dosage of LPS to lactating female mice (50, 400 or 1000 μ g/kg) and found that dams still expressed aggression toward an intruder male compared with saline. At a 400 μ g/kg dosage of LPS, they found no significant difference with control when focusing on different components of the nest defence (i.e. proportion of aggression, latency of the first attack, frequency of attacks), however, treated female displayed the typical symptoms of an immune challenge at this dosage (reduced social investigation, increased immobility).

One possible proximate mechanism that can sustain such a reduction in active agonistic response, can involve the activation of the hypothalamo-pituitary adrenal axis (HPA-axis). Indeed female rodents display a physiological hypo-responsiveness to stress with a disruption in HPA-axis activity (Lightman et al., 1998). It has been argued that this particular state is a prerequisite to display agonistic responses towards an intruder in the case of the maternal nest defence and that activation of HPA-axis, through injection of corticotrophin-releasing factor (CRF), inhibits maternal aggression (Gammie et al., 2004; Maestriperi and D'Amato, 1991). Cytokines, released during the activation of the innate immune system, are known to induce an activation of HPA-axis (Besedovsky et al., 1991). Thus, it is possible that the decrease in the expression of offensive components of aggression can be mediated by the HPA-axis activation during the inflammatory response. This hypothesis was tested in a previous work by Weil et al. who showed an increased corticosterone level after this particular aggression test. Moreover, this specific decrease in the offensive component of aggression has been observed in another type of aggression encounter involving two unfamiliar males (Cirulli et al., 1998). In this particular study, involving an interaction with another highly aggressive healthy male, authors shown that males treated with various dosage of IL-1 β specifically decreased their expression of offensive components without any reduction of the defensive

aspects. Studies on the expression of particular offensive aspects of aggression usually refer to the hypothalamic attack area (for review, see Siegel et al., 1999). It can therefore also be hypothesized that pro-inflammatory cytokines, synthesized during the inflammatory response, can act on specific structures involved in the control of offensive aggression to specifically disrupt this component in LPS-treated mice (Halasz et al., 2002). It seems quite clear that lactating mice experiencing an acute phase response are still able to modify the expression of sickness behaviour and decrease the recovery process in order to cope with a threatening situation. This kind of situation does not only involve a direct danger for the animal but also for its pups thus demonstrating that sickness behaviour remains flexible and can be kept aside to avoid a decrease in the fitness of the animal. The sickness motivation is bypassed by the motivation to defend the pups and the lactating female can express agonistic behaviours that are sufficient to keep the threat away from the nest area.

Finally, the analysis of the 70 kHz USVs emitted by the male in the study by Renault et al. (2007) showed that a discrimination is done between the two groups of females, with a lower quantity of vocalizations emitted when interacting with a female displaying the symptoms of acute inflammation (Renault et al., 2007). Moreover, the immune-challenged females appeared to be more responsive to male's calls than control (i.e. they expressed more agonistic behaviours for the same amount of ultrasonic calls). Indeed, the major direct communication mode used by rodents is based on the emission of ultrasonic vocalizations (USVs; Sales and Pye, 1974). This kind of vocalizations was first described as an infant behaviour in mice (Noirot, 1966). But other studies showed that 70 kHz USVs are also emitted by male in the presence of female during sexual courtship and copulation (Sales, 1972; White et al., 1998). The role of 70 kHz USVs during male's courtship behaviour is likely to support female choice since the latter shows a preference for non-devocalized males (Pomerantz et al., 1983). On the other hand, the production of 70 kHz USVs by the male induces higher level of aggression from lactating females (Jay Bean et al., 1986). Therefore, the emission of USVs during the maternal aggression procedure is important to be assessed as a way to monitor sexual motivation (i.e. the threat level for the pups) expressed by the unfamiliar male. Indeed, the paradigm is mainly focused on the female's behaviour and not on the interactions between the female and the intruder that can influence the progress of the encounter (Blanchard et al., 2003). A previous study already showed that male rats are able to discriminate between IL-1 β - and saline-treated females (Avitsur et al., 1997). In that study authors showed that males spent less time and performed less sexual behaviours towards a female treated with IL-1 β when they had the choice with another healthy one. In that case, the consummatory phase of reproductive behaviour is disrupted leading to a decrease in the "quality" of the mounting and intromission phases. These results also show that the appetitive phase of sexual behaviour is also disrupted when a male is confronted to a female displaying the non-specific symptoms of infection. Indeed, 70 kHz USVs emitted by males during male-female interaction is an effective index for sexual arousal (White et al., 1998) and also acts on female to enhance their attractiveness (Pomerantz et al., 1983). The frequency of 70 kHz USVs has been shown to be associated with agonistic response during maternal nest-defence (Bean et al., 1986). These results show that LPS-treated females do not lower their reaction to males' sexual solicitations demonstrating their ability to perceive this social threat at least as well as healthy subjects.

SOCIAL INFLUENCE OF THE PRESENCE OF AN IMMUNE-CHALLENGED SOCIAL PARTNER: EFFECTS ON HEALTHY CONSPECIFICS

Immunity and Sociality in Vertebrates

During the setting up of the innate immune process infected subjects are potentially vectors of pathogens. Benjamin Hart convincingly argued that a way to bypass this possible contamination problem is to simply decrease direct physical contact toward sick individuals (Hart, 1990). This proposition is interesting because it implies that, besides the expression of a behavioural adaptation centred on the infected subject, sickness behaviour displayed by an individual can also be informative and adaptive for healthy conspecifics by decreasing their propensity to interact with the former. If this proposition is correct, healthy conspecifics would be expected to modify their behaviour when facing conspecifics experiencing an immune challenge. Some authors already investigated the consequence of an acute phase response on sexual motivation and mate choice in rats and showed a difference between males and females in regarding sexual behaviours (Avitsur et al., 1997; Yirmiya et al., 1995). Indeed, authors showed that female rats treated with either bacterial endotoxin or interleukin-1 β (IL-1 β , one of the main proinflammatory cytokines) displayed less prospective (solicitous) behaviours that serve to gain attention from the male and initiated less sexual activity toward a sexually motivated healthy male (Yirmiya et al., 1995). On the contrary, LPS- or IL-1-treated males, did not show any loss of motivation and sexual behaviours when confronted with healthy females (Avitsur et al., 1997). Moreover, when a sexually experienced male is given the choice between two possible female partners, IL-1 β - and saline-treated respectively, its preference goes for the healthy partner. Such a bias in sexual preference is interpreted as a loss of “sexual attractiveness” from the sick female (Avitsur et al., 1997). In that study, authors also observed the same result with healthy females choosing between both sick and healthy males but only after the injection of a high dose of IL-1 β . Interestingly, these studies showed that individuals from the social environment are able to react and modify their behaviour when facing a conspecific presenting the non-specific symptoms of an immune challenge. In addition to the explanation of a possible way to avoid contamination by a pathogen, it is now well known that endotoxin treatments during gestation results in foetal abnormalities or death (Silver et al., 1994; Zahl and Bjerknes, 1943) and the avoidance of mating with sick females can also be viewed as a way to avoid a high risk of pup loss. However, the major question that arises from these observations is whether the healthy subject reacts non-specifically to modifications in the behavioural repertoire of sick mates or if the inflammatory condition is recognized *per se*.

Studies using inflammatory models, such as the bacterial endotoxin, to examine their social consequences have been far less developed than studies relying on organisms infested with a parasite. There are major differences between those two models. First, contrary to LPS, infection by a parasite induces many neuroendocrine alterations in the host, but does not necessarily induce systemic inflammatory response (Correa-de-Santana et al., 2006; Fiore et al., 1998). Indeed, the parasite can induce specific symptoms (e.g. parasitic manipulation), which can overshadow nonspecific inflammatory responses (see reviews by Klein, 2003 and Thomas et al., 2005). For example, it has been shown that infection with *Toxoplasma gondii* (congenital or not) increases exploration behaviour and aggression in mice (Arnott et al.,

1990; Berdoy et al., 2000). Another example of the multiple strategies expressed by parasites to achieve their cycle is their ability to manipulate immune response. Indeed, parasites are able to produce immune-modulatory molecules like proopiomelanocortin-related peptides as well as some opiates (β -endorphin) that decrease the immune response of the hosts (Maizels et al., 2004; Salzet, 2000). Second, the LPS inflammatory model activates macrophages and induces the release of proinflammatory cytokines that consequently act on the brain and setup the behavioural and physiological changes that characterize the sick organism. Because it does not imply any living pathogen, it constitutes a reliable tool to specifically and temporarily activate the innate immune system without uncontrolled competitive side-effect induced by another organism. As such, it represents a valuable tool to better understand social changes induced by the inflammatory condition *per se*.

So far, studies in Psychoneuroimmunology mainly focused on the immune-activated subject, and inflammatory response has therefore been shown to induce adaptive changes in the host, at both physiological and behavioural levels, that help to fight infection (Dantzer, 2001). But as many potential hosts are social or sub-social animals, one could ask whether the activation of the immune system of one individual could be specifically perceived by its healthy conspecifics, and trigger specific responses (i.e. pathogen avoidance).

A recent experiment investigated the possible modification of social exploration of a sick subject (Renault et al., 2008). In a pilot study, Aubert et al. (unpublished data) found out that in a semi-natural environment (i.e. two arenas connected by a small tunnel, to allow the full development of possible avoidance strategies in either treated or non-treated mice), outbred Swiss mice kept in steady social group of three individuals do not show any modification in social or spatial behaviour when one of them is treated with endotoxin. The observations were done over a 24-hr period, and a special attention was granted to the social repertoire (including agonistic behaviours) and to the inter-individual distances. While the sick animal displayed the whole set of behavioural and physiological symptoms of acute inflammation (i.e. piloerection, lethargy, fever, curled-up posture), healthy individuals did not express any aggressive behaviour, or reduction in contacts, but continued to sleep stacked together. This absence of avoidance or isolation is intriguing because it does not match the theoretical proposition considering that one of the main adaptive strategies to promote fitness when an animal is in the presence of pathogens or parasites is to simply avoid contact with this potential contaminant (Hart, 1990). These observations lead to further investigate the social interactions between healthy and immune-activated subjects. More specifically there is a lack of evidence that the behavioural modifications of healthy conspecifics toward an immune-challenged animal (e.g reduced sexual attractiveness) are sustained by behavioural symptoms of inflammation (reduction in locomotor activity or decrease in active social behaviours for example). These changes can also be expressed because of specific biological/olfactive cues produced during the inflammation process that are perceived by healthy animals. To test this hypothesis, Renault et al. (2008) used semi-lethargic animals as controls (i.e. to mimic behavioural symptoms following an endotoxin treatment). Indeed, untreated animals are more likely to display active social interactions that would interfere with possible olfactive cues they could display. Therefore, authors used ketamine instead of saline as control treatment. Indeed, a mild ketamine treatment is well known to reduce locomotor and active social behaviours without a total anaesthetic effect. The lack of an effect does not necessarily mean that healthy animals are not able to perceive or identify the inflammatory condition of their LPS-treated conspecifics. It is for example possible that the standard environmental in which

observations occurred did not provide any relevant functional significance to the sickness of their mate.

To test such a possibility, Renault et al. (2008) also modified the context in which encounters took place. This was done with a specific non-noxious unsanitary olfactory component (1,5-diaminopentane, also known as cadaverine), that provides a relevant context for the animal (i.e. signalling the presence of a possible decaying corpse in the environment). Authors used such an olfactory stimulation in order to bypass a possible lack of relevant motivational state of healthy mice confronted to LPS-treated conspecifics in standard conditions. This compound has already been used to induce specific emotional arousal in rodents. Indeed, cadaverine is a biogenic amine resulting from the decomposition of animal tissues. This olfactory compound has been shown to induce hygienist behaviours such as non-defensive burying in rats without an aversive effect if coupled with food ingestion (Montoya et al. 1981). Contrary to defensive burying, which is displayed in the presence of an aversive stimulus, the non-defensive burying is considered as hygienist behaviour, i.e. behaviour intended to promote hygiene and reduce contacts with pathogens. Indeed, burying of decaying conspecifics bodies can be viewed as a way to decrease possible contamination by bacteria particularly when there is no possibility to keep off (De Boer and Koolhaas, 2003).

The study revealed the absence of any agonistic behaviour (either aggressive or defensive) in healthy mice during dyadic encounters with either ketamine- or LPS-treated mice (Renault et al., 2008). This excludes any coercive way to actively isolate or contain the sick conspecific from healthy individuals. Furthermore, it must be noted that healthy mice pre-exposed to cadaverine did not express non-defensive burying directed toward the stimuli animals. Contrary to the experiment by Montoya and colleagues, the cadaverine was used to modify emotional arousal to induce specific relevance of the situation and was not present during the dyadic encounter. In addition to this different modality of exposition to this compound, the encounter lasted for 5 minutes and one can figure that this relatively short period of interaction did not allow healthy animals to express such hygienist behaviours. This absence of burying is in accordance with the absence of agonistic behaviours throughout the experiment.

The validity of the ketamine model, that was used to decrease the expression of active social sniffing behaviours, was also assessed. Indeed, the stimuli mice used for this experiment and treated with ketamine did not show a higher propensity to display active social sniffings thus demonstrating the validity of the ketamine treatment to model the reduction in social activities displayed by immune-challenged individuals. Moreover, in standard conditions, mice spend the same amount of time in contact with a LPS-treated subject than with a ketamine-treated mouse, thus confirming previous observations of steady social behaviour of free-living mice in a semi-natural environment toward an endotoxin-treated mate (Aubert et al., unpublished data). Therefore, there is not any noticeable difference in the total number of allo-sniffing. However, test subjects displayed a higher proportion of muzzle sniffing toward the LPS-treated subjects, whatever the pre-exposition odour conditions. Interestingly, results showed that the pre-exposition to cadaverine led to a decreased duration of contact in mice exposed to LPS-treated conspecifics. In the same way, the distance between the subjects and the stimuli mouse was greater in the case where one of the mice displayed the symptoms of inflammation and infection (Renault et al., 2008).

In addition to this reduction of the contact duration, results showed a modification in the mode of social exploration toward the LPS-treated subject. Indeed, the number of active

sniffing behaviours is not modified, whereas there is a statistical tendency for an increased proportion of social sniffing after an exposition to cadaverine toward LPS-treated mice. The analysis of the mode of social exploration revealed an increased frequency of muzzle sniffing (at the expense of ano-genital sniffing) oriented toward sick mice, whereas the proportion of muzzle sniffing is reduced after the pre-exposition to cadaverine as the relative proportion of ano-genital sniffing is decreased.

This study by Renault et al. (2008) was the first to bring out the behavioural discrimination of the inflammatory condition of an individual by a healthy conspecific that is not linked with a reduction in social solicitations as well as the importance of the environmental context in which this discrimination occurs. Contrary to studies on parasite avoidance, no study has clearly demonstrated pathogen avoidance through social isolation of a possible contaminant subject. Authors showed that, in standard conditions, there is no active social isolation displayed by healthy conspecifics suggesting either that they don't perceive or pay attention to the specific condition of their conspecifics or that the specific immune condition is not salient. However, following a specific odour pre-exposure (cadaverine), mice explored differently vehicle and LPS-treated conspecifics. This environmental condition was used in order to change the functional meaning of the inflammatory state of the non-familiar conspecific and reinforce the appropriate motivational factors supported by the cues from LPS-mice. In such circumstances, Renault et al. (2008) observed that subjects modify their behaviour and limit contacts with the sick mice, thus demonstrating their ability to discriminate sickness in their conspecifics. Contrary to previous studies concerning the avoidance of LPS-treated conspecifics, it is clear now that the modification in the social exploration is not the result of a decrease in locomotion or "social disinterest" in LPS-treated animals. Indeed, these modifications did not occur when the stimulus was treated with a low dose of sedative mimicking the lethargic state (i.e. mimic social disinterest) and decreasing the locomotor activity usually observed during an immune challenge.

As described above, following the pre-exposition to cadaverine, mice adopt a different mode of social exploration of LPS-treated animals that can be viewed as a modification in the behavioural strategy expressed toward the sick conspecific by conspecifics. Indeed, in his germinal paper, Hart (1990) proposed two mechanisms in order to achieve a better control of possible contamination induced by social interactions. One of these strategies is the "controlled exposure", described as a way to stimulate the immune system and facilitate disease resistance. According to such a strategy, the exposition to a relatively low dose of pathogen can stimulate the production of specific antibodies and develop specific immunocompetence, thus acting as a "social vaccination". Such a process has already been described by some authors studying eusocial insect models and more precisely in the dampwood termites *Zootermopsis angusticollis* (Traniello et al., 2002). It has been demonstrated that the exposure to immunized nestmates induce a better resistance to a forthcoming fungal infection by *Metarhizium anisopliae*, suggesting the possibility of a "social vaccination". Moreover, a recent study in another eusocial species (*Formica polyctena* ants) provides further support to such a hypothesis (Aubert and Richard, 2008). Indeed, ants have been found to increase body licking of a LPS-treated nest-mate (i.e. the possible mechanism for such a "social vaccination"), but decrease drastically the massive mouth-to-mouth fluid exchanges (i.e. trophallaxis), that would rather represent a "controlled exposure" strategy (Aubert and Richard, 2008).

On the other hand, animals can adopt an “avoidance strategy” that leads to a decrease in physical contacts toward an infected subject. From this study, one can hypothesize that under control conditions mice adopted a controlled exposure strategy and start to “switch” to another type such as an avoidance one by decreasing their contact time and promiscuity with immune-challenged subjects. However, there is no real avoidance strategy since mice did not express agonistic or burying behaviours directed toward their sick conspecific.

The environment in which the encounters took place plays a key role in the choice of the strategy used to avoid contamination by controlling the exposition to the potential source of infection. This point of view matches a “Risk vs. Reward” point of view (Houston and McNamara, 1999). Indeed, controlled exposure to a pathogen provides the development of immunological competence, which can be useful on a subsequent exposition to the same type of pathogen. Such a “social vaccination”, as described earlier, is less likely to occur under the “avoidance of the source” strategy but, in that case, the risk to develop disease is higher as the potential exposition to pathogenic elements is increased.

Considering the ability of cadaverine to trigger specific behaviours directed to the stimulus animal, it is interesting to consider this unsanitary olfactory exposition as behavioural priming. Indeed, 1,5-diaminopentane facilitates the expression of hygienist (e.g. non-defensive burying) behaviours in rat (Montoya, 1981). One could therefore hypothesize that an animal “primed” with cadaverine would be more sensitive than controls to an upcoming potential pathogen exposure. In the study by Renault et al. (2008), the consequences of such behavioural priming would be the elicitation of a specific behavioural pattern directed to sick mice such as the decrease in contact duration and the reduced proportion of ano-genital sniffing.

These results open new questions mainly regarding underlying mechanisms involved in such discrimination of the “sickness state”. Studies concerning underlying mechanisms of pathogen avoidance brought out interesting results regarding the evolutionary roots of innate immunity. Indeed, recent works investigated the involvement of some chemosensory signalling pathways that were linked to the expression of avoidance behaviours. One example comes from the nematode worm *Caenorhabditis elegans* and brought in light the critical role of the Toll-1 signalling pathway in this species for the expression of pathogen avoidance (Pujol et al., 2001). The interesting result comes from the involvement of toll signalling pathways because of their highly conservation among evolution in both vertebrates and invertebrates innate immunity (Kopp and Medzhitov, 1999). It can be hypothesized that a similar pathway can be involved in the case of “sickness” recognition and avoidance in mammals and, therefore in rodents. Recent studies by Kavaliers et al. (Kavaliers et al., 2006; Kavaliers et al., 2005) showed an important role for the oxytocin gene in the recognition and decision making of female mice when confronted with a parasitized male. Thus, these findings reinforce the idea of a central role of oxytocin and vasopressin in the expression of many socially-related behaviours (Carter, 1998; Ferguson et al., 2001). In the recognition of the inflammatory state described in that study, it would be interesting to verify if such underlying mechanisms are involved. On the other hand, central or systemic injection of the pro-inflammatory cytokine IL-1 β stimulates the release of both central and systemic vasopressin and oxytocin in rats via noradrenergic projections (Brunton et al., 2006; Landgraf et al., 1995). This activation of oxytocin neurons is mainly distributed in the supraoptic (SON) and paraventricular nuclei (PVN) of the hypothalamus. Oxytocin is a neuro-hormone that is also released after exposure to certain types of stressors such as immobilization, forced

swimming or during maternal defence of the nest by a lactating female (Lang et al., 1983; Neumann et al., 2001).

When non-familiar mice are exploring each other, they engage in intense sniffing, including the ano-genital and muzzle areas as well as other body parts (Brown and Macdonald, 1985). The social exploration of the ano-genital part of the body provides useful information about the animal such as social status, sex, sexual state and also the individual unique odour displayed by the expression of histocompatibility genes (Brown et al., 1987; Singh et al., 1987). On the opposite, sniffing the anterior part of the body, especially the muzzle area, brings information about the recent activities of the subject and is generally associated with recent food ingestion (Galef, 2002). The increase in the relative frequency of muzzle exploration without modification of ano-genital sniffing can lead to the investigation of the possible functional relevance in this modification. For example, mouse breath is involved in conveying information about recently ingested food. It is generally observed when considering the social transmission of food preference in rodents because of the presence of a volatile substance like carbon disulfide, in addition to the recently eaten food odour (Galef et al., 1988).

Immunity and Sociality in Invertebrates

Defences against pathogens and diseases have been preserved over millions of years of evolution and are remarkably well conserved across species, from invertebrates to vertebrates (Aubert, 2007; Borregard et al., 2000). In particular, the innate immune system, which responds to bacteria, fungi, viruses and other parasites, is very similar even at the molecular level in such diverse phyla as mammals, insects, and even plants (Hoffmann, 2003; Magor and Magor, 2001). This includes various receptors (i.e. Toll-like receptors) that recognize classes of microbial cell-surface molecules, common signal transduction pathways (i.e. NF- κ B pathway) that activate transcription of genes related to host defence, and some ubiquitous cationic peptides (i.e. cathelicidins and defensins) that act as antimicrobial effectors. However, while molecular responses to pathogens have been the main focus of research, behavioural responses can also serve a critical role (Aubert, 1999; Aubert and Renault, 2007). Indeed, research in mammals suggests that immune-stimulated individuals isolate themselves from the healthy individuals in their social group (Dantzer, 2004), which would represent an adaptive strategy to protect non-infected conspecifics (Hart, 1988). However, it is not clear whether changes in social interactions truly represent a general and conserved mechanism for limiting disease transmission in social groups. Taking into account such issues, invertebrates constitute valuable models for further development in Psychoneuroimmunology (Adamo 2006; Aubert, 2007). More specifically, insects represent relevant and convenient models to better understand immune-related behaviours and the evolutionary processes that are involved, due to their incredible biodiversity. Moreover, social insects (ants, honeybees and termites) provide an excellent opportunity to study pathogens transmission due to the high density of individuals and close social interactions (Naug and Camazine, 2002; Pie et al., 2004; Sherman et al., 1988; Sherman et al., 1998).

Social insect colonies have been assimilated as super-organisms, where the colony represents a whole organism, and the individual insects represent single cells (Wilson, 1971; Hölldobler and Wilson, 1990). In this representation, the organism will protect itself from

other organisms and intruders. As in an organism, an infected cell is simply eliminated (e.g. phagocytosis or apoptosis), it could be predicted that in a social insect colony, an infected worker would be eliminated to prevent pathogen dissemination. Thus, one could expect to observe either the direct elimination of the infected individual by the nestmates (as phagocytosis in an organism), or the self-destruction of the infected individual. Such a mechanism refers to phenoptosis (i.e. the programmed death of an organism), where an individual activates cellular mechanisms that induce it to degenerate and die (Skulachev, 1999). Alternatively, the individual might simply remove itself from the colony by engaging in riskier tasks, or tasks that keep it separated from the core of the colony (i.e. the reproducers).

Social insects seem to have evolved various behavioural adaptations to avoid or fight infections resulting in avoidance, control or elimination of the parasitic infection. As predicted by the phenoptosis model, parasitized bumblebee workers stay outside overnight rather than returning to their nest and actively seek out colder temperatures (Müller and Schmid-Hempel, 1993), which delays the development of the parasite, but implies more lethal risks (e.g. predation) for the infected individual. Alternatively, when a parasite has penetrated an ant or termite a colony, the parasite can be physically removed by allo-grooming. Allo-grooming will result in decreased mortality from fungal infection in grouped insects compared to mortality in isolated individuals (Calleri II et al., 2006; Hughes et al., 2002). On the other hand, a by-product of sociality is increased nestmate interactions. These can also be the Achilles' heel of social insects since it could increase parasite transmission.

In a recent study by Aubert and Richard (2008), the behavioural responses of social insects to an infected nestmate were evaluated. As one of the most diverse groups of social insects, authors used ants as a model in this study. Using bacterial endotoxin (LPS), they specifically activated the innate immune system of individual insects, and monitored the responses of healthy nestmates. First, LPS did not increase mortality in ants, nor reduce locomotion per se or self-grooming capabilities. Hence, possible deleterious effects of LPS injections cannot account for the social changes they observed.

The phenoptosis hypothesis would have predicted the elimination of infected individuals, which was not supported by the results of Aubert and Richard (2008). LPS-treated ants experience increase in social contacts (i.e. antennal contacts and allo-grooming) but no increase in agonistic behaviour. Based on super-organism theory, one would expect to have a decrease in social contacts (i.e. avoidance of a potential source of infection) or increased aggression (i.e. removal of a potential source of infection) to limit pathogen transmission. However, if ants engaged in more social contacts (i.e. antennal contacts and allo-grooming), there was less direct fluid exchanges through trophallaxis and a socially-induced limitation of LPS-treated locomotion (i.e. by groomers activity and density around the LPS-treated ant). These last two results could be considered as pathogen transmission limitation (i.e. decrease of massive inter-individual exchanges and decrease of infected nestmate's mobility) (Hart, 1990).

In parasitized termites and ants, the presence of nestmates and the expression of allo-grooming behaviour increase survivorship and pathogen resistance (Calleri II et al., 2006; Hughes et al., 2002). Indeed, Hughes et al (2002) found less of fungus particles on the cuticle over time; however, this was observed in both isolated and group-reared termites. However, besides physical removal of external pathogens, allo-grooming could also permit (as in this case) the exposure and distribution of a small amount of an internal pathogen, and/or

immuno-active molecules. The benefits of this type of transmission could depend on the infected agent or pathogens. Allo-grooming could potentially benefit the group by resulting in a “social vaccination” (i.e. the social “transfer” of immunity) of the naïve nestmates (Traniello et al., 2002). Indeed, rearing naïve termites with termites previously exposed to pathogens (i.e. a suspension of the entomopathogenic fungus *Metarhizium anisopliae*) can improve the subsequent resistance of the naïve termites to a challenge with a fungal pathogen (Traniello et al., 2002). Aubert and Richard (2008) propose evidence for the behavioural mechanisms underlying such a social transfer of immunity. Their findings would therefore correspond to the behavioural mechanisms, in *F. polyctena* ants, of a “controlled exposure” strategy (Hart, 1990). Indeed, the controlled exposure to a pathogen has been argued to facilitate the development of immunological competence, which could be useful on a subsequent exposition to the same type of pathogen, and would promote disease resistance (Hart, 1990).

This anticipatory immuno-activation, or transfer of immunity (Traniello et al., 2002) could be allowed by grooming, through the absorption of small amounts of pathogens fragments or immuno-active molecules produced by the infected host, thus stimulating immune defences of naïve conspecifics. Even if such a question has not been specifically addressed, known features of the cuticle’s physiology offer interesting leads. Indeed, after immune stimulation, fat bodies and haematocytes secrete antimicrobial peptides and enzymes into the haemolymph (Kim and Kim, 2005). As noted by Schal et al. (Schal et al., 1998), an active association exists between haemolymph and the cuticle since compounds from the haemolymph (which can include immuno-active molecules released by fat bodies or amoebocytes) are readily transported to the outer epicuticular surface (Fan et al., 2003). Therefore, such a mechanism could be implied in the possible transport of immuno-active substances to the cuticle (Siva-Jothy et al., 2005). However, further research is necessary to specifically address the question of the trans-cuticular transfer of immune-active molecules.

CONCLUSION

During the past decades, Psychoneuroimmunology studies in vertebrates revealed adaptive function of immune-induced behavioural changes, which are supported by immune-to-brain communication (Hart, 1988; Dantzer, 2004; Aubert and Renault, 2007). In terms of social interactions, previous studies have focused on mammalian species such as mice or rats, where social disinterest of immuno-stimulated individuals (Dantzer, 2004) has been argued to represent an adaptive strategy to protect healthy conspecifics (Hart, 1990). However, if results are rather clear concerning parasitic models (i.e. where possible sensory cues from the infected organism come both from the parasite and the host), it is not the case for inflammatory models such as LPS (i.e. where possible sensory cues can only be dependent on the host). Recent experimental studies (Renault et al., 2008; Aubert and Richard, 2008) provide clear evidence of behavioural changes in healthy individuals toward immuno-stimulated conspecifics both in vertebrates and in invertebrates, and show that non-replicative immune activation triggers behavioural changes in social partners. These findings provide new insight into social management of infection by healthy partners and support the importance of social context to further understand the immune-induced behavioural changes.

REFERENCES

- Adamo, S.A., 2006. Comparative Psychoneuroimmunology: Evidence from the insects. *Behav. Cog. Neurosci. Rev.* 5, 128-140.
- Arnott, M.A., Cassella, J.P., Aitken, P.P., Hay, J., 1990. Social interactions of mice with congenital *Toxoplasma* infection. *Ann. Trop. Med. Parasitol.* 84, 149-156.
- Aubert, A. and Renault, J., 2008. Cytokines and immune-related behaviors, in: E. K. C. Phelps, editor. *Neuroimmune Biology* Elsevier Science.
- Aubert, A., 1999. Sickness and behaviour in animals: a motivational perspective. *Neurosci. Biobehav. Rev.* 23, 1029-1036.
- Aubert, A., 2007. Invertebrates studies and the evolution of comparative psychoneuroimmunology. *Brain Behav Immun* 21:290-291.
- Aubert, A., Goodall, G., Dantzer, R., Gheusi, G., 1997a. Differential effects of lipopolysaccharide on pup retrieving and nest building in lactating mice. *Brain Behav. Immun.* 11, 107-118.
- Aubert, A., Kelley, K.W., Dantzer, R., 1997b. Differential effect of lipopolysaccharide on food hoarding behavior and food consumption in rats. *Brain Behav. Immun.* 11, 229-238.
- Aubert, A., Richard, F.J., 2008. Social management of LPS-induced inflammation in *Formica polyctena* ants. *Brain Behav. Immun.* 22, 833-837.
- Avitsur, R., Cohen, E., Yirmiya, R., 1997. Effects of Interleukin-1 on Sexual Attractivity in a Model of Sickness Behavior. *Physiol. Behav.* 63, 25-30.
- Bean, N.J., Nunez, A.A., Wysocki, C.J., 1986. 70-kHz vocalizations by male mice do not inhibit aggression in lactating mice. *Behav. Neural Biol.* 46, 46-53.
- Berdoy, M., Webster, J.P., MacDonald, D.W., 2000. Fatal attraction in rats infected with *Toxoplasma gondii*. *Proc. R. Soc. B: Biological Sciences* 267, 1591-1594.
- Besedovsky, H.O., Del Rey, A., Klusman, I., Furukawa, H., Monge Arditi, G., Kabiersch, A., 1991. Cytokines as modulators of the hypothalamus-pituitary-adrenal axis. *The Journal of Steroid Biochemistry and Molecular Biology* 40, 613-618.
- Blanchard, R.J., Caroline Blanchard, D., 1977. Aggressive behavior in the rat. *Behav. Biol.* 21, 197-224.
- Blanchard, R.J., Wall, P.M., Blanchard, D.C., 2003. Problems in the study of rodent aggression. *Horm. Behav.* 44, 161-170.
- Bluthe, R.-M., Dantzer, R., Kelley, K.W., 1992. Effects of interleukin-1 receptor antagonist on the behavioral effects of lipopolysaccharide in rat. *Brain Res.* 573, 318-320.
- Borregard, N., Elsbach, P., Ganz, T., Garred, P. and Svejgaard, A., 2000. Innate immunity from plants to humans. *Immun. Today* 21:68-70.
- Breed, M. D., 1983. Nestmate recognition in honey bees. *Anim. Behav.* 31:86-91.
- Brivio, M. F., Mazzei, C. and Scari, G., 1996. proPO system of *Allogamus auricollis* (Insecta): Effects of various compounds on phenoloxidase activity. *Comp. Biochem. Physiol. B Biochem. Mol. Biol.* 113: 281-287.
- Brown, R.E., Macdonald, D.W., 1985. *Social odours in mammals.* Oxford University Press, Oxford.
- Brown, R.E., Singh, P.B., Roser, B., 1987. The Major Histocompatibility Complex and the chemosensory recognition of individuality in rats. *Physiol.Behav.* 40, 65-73.

- Brunton, P.J., Sabatier, N., Leng, G., Russell, J.A., 2006. Suppressed oxytocin neuron responses to immune challenge in late pregnant rats: a role for endogenous opioids. *Eur. J. Neurosci.* 23, 1241-1247.
- Calleri II, D. V., McGrail Reid, E., Rosengaus, R. B., Vargo, E. L. and Traniello, J. F. A., 2006. Inbreeding and disease resistance in a social insect: effects of heterozygosity on immunocompetence in the termite *Zootermopsis angusticollis*. *Proc. R. Soc. B* 273:2633-2640.
- Carter, S.C., 1998. Neuroendocrine Perspectives On Social Attachment And Love. *Psychoneuroendocrinology* 23, 779-818.
- Cirulli, F., De Acetis, L., Alleva, E., 1998. Behavioral effects of peripheral interleukin-1 administration in adult CD-1 mice: specific inhibition of the offensive components of intermale agonistic behavior. *Brain Res.* 791, 308-312.
- Correa-de-Santana, E., Paez-Pereda, M., Theodoropoulou, M., Kenji Nihei, O., Gruebler, Y., Bozza, M., Arzt, E., Villa-Verde, D.M.S., Renner, U., Stalla, J., Stalla, G.K., Savino, W., 2006. Hypothalamus-pituitary-adrenal axis during *Trypanosoma cruzi* acute infection in mice. *J. Neuroimmunol.* 173, 12-22.
- Crestani, F., Seguy, F., Dantzer, R., 1991. Behavioural effects of peripherally injected interleukin-1: role of prostaglandins. *Brain Res.* 542, 330-335.
- Dantzer, R., 2001. Cytokine-induced sickness behavior: where do we stand? *Brain Behav. Immun.* 15, 7-24.
- Dantzer, R., 2004. Innate immunity at the forefront of psychoneuroimmunology. *Brain Behav. Immun.* 18:1-6.
- Dantzer, R., Aubert, A., Goodall, G., Bret-Dibat, J.L., Kent, S., Goujon, E., Laye, S., Parnet, P., Kelley, K.W., 1996. Cytokines actions on behaviour. In: Rothwell N.J. (Ed.), *Cytokines in the nervous system*. Landes, Austin.
- De Boer, S.F., Koolhaas, J.M., 2003. Defensive burying in rodents: ethology, neurobiology and psychopharmacology. *Euro. J. Pharmacol.* 463, 145-161.
- Fan, Y., Zurek, L., Dykstra, M. J. and Schal, C., 2003. Hydrocarbon synthesis by enzymatically dissociated oenocytes of the abdominal integument of the German Cockroach, *Blattella germanica*. *Naturwissenschaften* 90:121-126.
- Ferguson, J.N., Aldag, J.M., Insel, T.R., Young, L.J., 2001. Oxytocin in the Medial Amygdala is Essential for Social Recognition in the Mouse. *J. Neurosci.* 21, 8278-8285.
- Fiore, M., Alleva, E., Moroni, R., Aloe, L., 1998. Infection with *Schistosoma mansoni* in mice induces changes in nociception and exploratory behavior. *Physiol.Behav.* 65, 347-353.
- Fishkin, R.J., Winslow, J.T., 1997. Endotoxin-induced reduction of social investigation by mice: interaction with amphetamine and anti-inflammatory drugs. *Psychopharmacologia* 132, 335-341.
- Galef, B.G., Jr., 2002. Social learning of food preferences in rodents: Rapid appetitive learning. In: J. N. Crawley, C.R.G., M. A., Rogawski, D. R. Sibley, P. Skolnick, S. Wray (Ed.), *Current protocols in neuroscience*. Wiley, New York.
- Galef, B.G., Mason, J.R., Preti, G., Bean, N.J., 1988. Carbon disulfide: A semiochemical mediating socially-induced diet choice in rats. *Physiol.Behav.* 42, 119-124.
- Gammie, S.C., Negron, A., Newman, S.M., Rhodes, J.S., 2004. Corticotropin-releasing factor inhibits maternal aggression in mice. *Behav. Neurosci.* 118, 805-814.

- Gandelman, R., 1972. Mice: Postpartum aggression elicited by the presence of an intruder. *Horm. Behav.* 3, 23-28.
- Grant, E.C., Mackintosh, J.H., 1963. A comparison of the social postures of some common laboratory rodents. *Behaviour* 21, 246-259.
- Halasz, J., Liposits, Z., Meelis, W., Kruk, M.R., Haller, J., 2002. Hypothalamic attack area-mediated activation of the forebrain in aggression. *Neuroreport* 13, 1267-1270.
- Hart, B.L., 1988. Biological basis of the behavior of sick animals. *Neurosci. Biobehav. Rev.* 12, 123-137.
- Hart, B.L., 1990. Behavioral adaptations to pathogens and parasites: Five strategies. *Neurosci. Biobehav. Rev.* 14, 273-294.
- Hoffmann, J. A., 2003. The immune response of *Drosophila*. *Nature* 426:33-38.
- Hölldobler, B. and Wilson, E. O. 1990. *The Ants*. Cambridge, Belknap Press.
- Houston, A.I., McNamara, J.M., 1999. *Models of adaptive behaviour*. Cambridge University Press.
- Hrdy, S.B., 1979. Infanticide among animals: A review, classification, and examination of the implications for the reproductive strategies of females. *Ethology and Sociobiology* 1, 13-40.
- Hughes, W. O. H., Eilenberg, J. and Boomsma, J. J., 2002. Trade-offs in group living: transmission and disease resistance in leaf-cutting ants. *Proc. R. Soc. B* 269:1811-1819.
- Imler, J. L., Tauszia, S., Jouanguy, E., Forestier, C. and Hoffmann, J. A., 2000. LPS-induced immune response in *Drosophila*. *J. Endo. Res.* 6:459-462.
- Imre, G., Fokkema, D.S., Boer, J.A.D., Ter Horst, G.J., 2006. Dose-response characteristics of ketamine effect on locomotion, cognitive function and central neuronal activity. *Brain Res. Bull.* 69, 338-345.
- Jay Bean, N., Nunez, A.A., Wysocki, C.J., 1986. 70-kHz vocalizations by male mice do not inhibit aggression in lactating mice. *Behav. Neural Biol.* 46, 46-53.
- Kavaliers, M., Choleris, E., Agmo, A., Braun, W.J., Colwell, D.D., Muglia, L.J., Ogawa, S., Pfaff, D.W., 2006. Inadvertent social information and the avoidance of parasitized male mice: A role for oxytocin. *Proc. Natl Acad. Sci. USA* 103, 4293-4298.
- Kavaliers, M., Choleris, E., Pfaff, D.W., 2005. Recognition and avoidance of the odors of parasitized conspecifics and predators: Differential genomic correlates. *Neurosci. Biobehav. Rev.* 29, 1347-1359.
- Kent, S., Bluthé, R.-M., Kelley, K.W., Dantzer, R., 1992. Sickness behavior as a new target for drug development. *Trends Pharmacol. Sci.* 13, 24-28.
- Kim, T. and Kim, Y.-J., 2005. Overview of innate immunity in *Drosophila*. *J Bioch Mol Biol* 38(2):131-127.
- Klein, S.L., 2003. Parasite manipulation of the proximate mechanisms that mediate social behavior in vertebrates. *Physiol. Behav.* 79, 441-449.
- Kopp, E.B., Medzhitov, R., 1999. The Toll-receptor family and control of innate immunity. *Curr. Opin. Immunol.* 11, 13-18.
- Korner, P. and Schmid-Hempel, P., 2004. In vivo dynamics of an immune response in the bumble bee *Bombus terrestris*. *J. Invertebr. Pathol.* 87:59-66.
- Landgraf, R., Neumann, I., Holsboer, F., Pittman, Q.J., 1995. Interleukin-1-beta stimulates both central and peripheral release of vasopressin and oxytocin in the rat. *Euro. J. Neurosci.* 7, 592-598.

- Lang, R.E., Heil, J.W.E., Ganten, D., Hermann, K., Unger, T., Rascher, W., 1983. Oxytocin unlike vasopressin is a stress hormone in the rat. *Neuroendocrinology* 37, 314-316.
- Lightman, S., Windle, R., da Costa, A., Shanks, N., Ingram, C., 1998. Lactation: a physiological model of stress hyporesponsiveness of the neuroendocrine system. In: Levy A, G.E., Ben-Nathan D, de Kloet ER (Ed.), *New Frontiers in Stress Research: Modulation of Brain Function*. Harwood Academic Publishers, Amsterdam, pp. 59-71.
- Maestripieri, D., D'Amato, F.R., 1991. Anxiety and maternal aggression in house mice (*Mus musculus*): a look at interindividual variability. *J. Comp. Psychol.* 105, 295-301.
- Magor, B. G. and Magor, K. E., 2001. Evolution of effectors and receptors of innate immunity. *Dev. Comp. Imm.* 25:651-682.
- Maizels, R.M., Balic, A., Gomez-Escobar, N., Nair, M., Taylor, M.D., Allen, J.E., 2004. Helminth parasites - masters of regulation. *Immunol. Rev.* 201, 89-116.
- Montoya, C.P., Whishaw, I. Q. Sutherland, R. J. , 1981. Cadaverine and Burying in the Laboratory Rat. *Bull. Psych. Soc.* 18, 118-120.
- Müller, C. B. and Schmid-Hempel, P., 1993. Exploitation of cold temperature as defence against parasitoids in bumblebees. *Nature* 363:65-67.
- Naug, D. and Camazine, S., 2002. The role of colony organization on pathogen transmission in social insects. *J. Theor. Biol.* 215(4):427-439.
- Neumann, I.D., Toschi, N., Ohl, F., Torner, L., Kromer, S.A., 2001. Maternal defence as an emotional stressor in female rats: correlation of neuroendocrine and behavioural parameters and involvement of brain oxytocin. *Euro. J. Neurosci.* 13, 1016-1024.
- Noirot, E., 1966. Ultra-sounds in young rodents. I. Changes with age in albino mice. *Anim. Behav.* 14, 459-462.
- Parmigiani, S., Francesco Ferrari, P., Palanza, P., 1998. An evolutionary approach to behavioral pharmacology: using drugs to understand proximate and ultimate mechanisms of different forms of aggression in mice. *Neurosci. Biobehav. Rev.* 23, 143-153.
- Pie, M. R., Rosengaus, R. B., Traniello, J. F., 2004. Nest architecture, activity pattern, worker density and the dynamics of disease transmission in social insects. *J. Theor. Biol.* 226(1):45-51.
- Pomerantz, S.M., Nunez, A.A., Jay Bean, N., 1983. Female behavior is affected by male ultrasonic vocalizations in house mice. *Physiol. Behav.* 31, 91-96.
- Pujol, N., Link, E.M., Liu, L.X., Kurz, C.L., Alloing, G., Tan, M.-W., Ray, K.P., Solari, R., Johnson, C.D., Ewbank, J.J., 2001. A reverse genetic analysis of components of the Toll signaling pathway in *Caenorhabditis elegans*. *Curr. Biol.* 11, 809-821.
- Renault J., Gomes M., Aubert A. Effects of endotoxin-induced sickness in the behavioural response to a social threat in lactating mice. *Hormones and Social Behaviour*, IPSEN Workshop, Paris dec 2007.
- Renault, J., Aubert, A., 2006. Immunity and emotions: Lipopolysaccharide increases defensive behaviours and potentiates despair in mice. *Brain Behav. Immun.* 20, 517-526.
- Renault, J., Gheusi, G., Aubert, A., 2008. Changes in social exploration of a lipopolysaccharides-treated conspecific in mice: role of environmental cues. *Brain Behav. Immun.*, 22: 1201-1207.
- Ribeiro, C., Duvic, B., Oliveira, P., Givaudan, A., Palha, P., Simoes, N. and Brehélin, M., 1999. Insect immunity - effects of factors produced by a nematobacterial complex on immunocompetent cells. *J. Insect Physiol.* 45: 677-685.

- Robinson, G. E., 1987. Modulation of alarm pheromone perception in the honey bee: evidence for division of labor based on hormonally modulated response thresholds. *J. Comp. Physiol. A* 160:613-619.
- Sales, G., 1972. Ultrasound and mating behavior in rodents with some observations on other behavioural situations. *J Zool Lond* 168, 149-164.
- Sales, G., Pye, J., 1974. Ultrasonic communication by animals. Chapman and Hall, London.
- Salzet, M., 2000. Invertebrate molecular neuroimmune processes. *Brain Res. Rev.* 34, 69-79.
- Schal, C., Sevala, V. and Card, R. T., 1998. Novel and highly specific transport of a volatile sex pheromone by hemolymph lipophorin in moths. *Naturwissenschaften* 85:339-342.
- Schlenke, T. A. and McKean, K. A. A., 2005. Role for alcohol dehydrogenase in the *Drosophila* immune response? *Insect Mol. Biol.* 14: 175-178.
- Shanks, N., Windle, R.J., Perks, P., Wood, S., Ingram, C.D., Lightman, S.L., 1999. The Hypothalamic-Pituitary-Adrenal Axis Response to Endotoxin is Attenuated During Lactation. *J. Neuroendocrinol.* 11, 857-865.
- Sherman, P. W., Seeley, T. and Reeve, H. K., 1998. Parasites, pathogens, and polyandry in Honey Bees. *Am. Nat.* 151(4):392-396.
- Siegel, A., Roeling, T.A.P., Gregg, T.R., Kruk, M.R., 1999. Neuropharmacology of brain-stimulation-evoked aggression. *Neurosci. Biobehav. Rev.* 23, 359-389.
- Silver, R.M., Lohner, W.S., Daynes, R.A., Mitchell, M.D., Branch, D.W., 1994. Lipopolysaccharide-induced fetal death: the role of tumor-necrosis factor alpha. *Biol. Reprod.* 50, 1108-1112.
- Silver, R.M., Lohner, W.S., Daynes, R.A., Mitchell, M.D., Branch, D.W., 1994. Lipopolysaccharide-induced fetal death: the role of tumor-necrosis factor alpha. *Biol. Reprod.* 50, 1108-1112.
- Singh, P.B., Brown, R.E., Roser, B., 1987. MHC antigens in urine as olfactory recognition cues. *Nature* 327, 161-164.
- Siva-Jothy, M. T., Moret, Y. and Rolff, J., 2005. Insect immunity: An evolutionary ecology perspective. *Adv. Ins. Physiol.* 32:1-48.
- Skulachev, V. P., 1999. Phenoptosis: programmed death of an organism. *Biochemistry* 64, 1418-1426.
- Svare, B., Betteridge, C., Katz, D., Samuels, O., 1981. Some situational and experiential determinants of maternal aggression in mice. *Physiol. Behav.* 26, 253-258.
- Thomas, F., Adamo, S., Moore, J., 2005. Parasitic manipulation: where are we and where should we go? *Behav. Proc.* 68, 185-199.
- Thor, D.H., Holloway, W.R., 1982. Social memory of the male laboratory rat. *J. Comp. Physiol. Psychol.* 96, 1000-1006.
- Traniello, J.F.A., Rosengaus, R.B., Savoie, K., 2002. The development of immunity in a social insect: Evidence for the group facilitation of disease resistance. *Proc. Natl Acad. Sci. USA.* 99, 6838-6842.
- Trivers, R.L., 1972. Parental investment and sexual selection. In: Campbell, B. (Ed.), *Sexual selection and the descent of man*. Aldine, Chicago, pp. 136-179.
- Weil, Z.M., Bowers, S.L., Dow, E.R., Nelson, R.J., 2006. Maternal aggression persists following lipopolysaccharide-induced activation of the immune system. *Physiol. Behav.* 87, 694-699.
- White, N.R., Prasad, M., Barfield, R.J., Nyby, J.G., 1998. 40- and 70-kHz Vocalizations of Mice (*Mus musculus*) during Copulation. *Physiol. Behav.* 63, 467-473.

Wilson, E.O., 1971. The insect societies. Cambridge, M.A., Belknap Press.

Wolff, J.O., 1985. Maternal aggression as a deterrent to infanticide in *Peromyscus leucopus* and *P. maniculatus*. Anim. Behav. 33, 117-123.

Yirmiya, R., Avitsur, R., Donchin, O., Cohen, E., 1995. Interleukin-1 Inhibits Sexual Behavior in Female but Not in Male Rats. Brain Behav. Immun. 9, 220-233.

Zahl PA., Bjerknes C., 1943. Induction of decidua-placental hemorrhage in mice by the endotoxins of certain gram-negative bacteria. Proc. Soc. Exp. Biol. Med. 54, 329-332.

Chapter 2

**CULTURE, SOCIAL INTERACTIONS, AND NATURAL
RESOURCES: SOME REFLECTIONS ON CULTURE AS
SOCIAL CAPITAL AND JULIAN SIMON'S ULTIMATE
RESOURCE IN LITHUANIA AND SWEDEN**

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ABSTRACT

In a free society, Julian Simon argues, increased population and income cause short-run resource scarcity that induces innovation, which leaves us better off than if the shortage problem had not arisen. Simon points out the importance of freedom from government coercion, and substantiates his argument of the innovative capability of free societies to overcome resource scarcities by empirical evidence, but he does not explore the social interactions behind his ultimate resource – human imagination acting together with educated skills in a free society – that is what economic personalism calls creative subjectivity of the human person. Culture provides the morality of social interaction in market, civil society, and state. Using Adam Smith's notion of fellow-feeling to describe sympathy, morality is a complex order that emerges through social interaction. Reciprocity is crucial to human cooperation and culture may include norms that create reciprocal sympathy. Cultural norms that yield reciprocal sympathy constitute social capital. This chapter argues that it is necessary to study the cultural foundations of a free society in order to understand why solutions to resource shortages are eventually found in such a society. Within the context of a correlated evolutionary Innovative Exchange game, market, civic, and political entrepreneurs are innovative agents, who interact through various combinations of exchange, integration, and threat, possibly establishing a price signaling system that makes them take the appropriate innovative action. Innovative

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exchange is an evolutionary process, because bounded rationality, genuine uncertainty, and rule following characterize innovation, while correlation gives some degree of non-anonymous interaction, thus facilitating coordination. The innovative agents create heterogeneous capital combinations, which form the capital structure of the economy. The purpose is to study how cultural differences in reciprocal sympathy between Lithuania and Sweden influence the possibility of promoting learning to overcome resource scarcities through economic integration within the Baltic Sea Area in the form of Baltic-Nordic learning networks. This would require that Baltic and Nordic cultures yield the same level of reciprocal sympathy. The historical-anthropological-interpretive approach adopted in this chapter develops a genealogy of institutions, regarding culture as a shared unified field of consciousness, whose structure is given by a shared history, thus corresponding to a mental map. The shared unified field of consciousness in Lithuania and Sweden, respectively, will be studied from today's perspective through indicators of values and beliefs and then look backwards to find their respective historical origins.

Keywords: *Culture, consciousness, social capital, the ultimate resource, knowledge creation, human development, evolutionary game theory, Lithuania, Sweden, Baltic Sea Area*

JEL Classification: *O12, O30, P51, Z13*

1. INTRODUCTION

Simon (1996) outlines a theory of resources, population, and economic progress, according to which increased population and income cause short-run resource shortages that induce innovation, if the political-social-economic system provides freedom from government coercion. The key is that solutions are eventually found in a free society, thus leaving us better off than if the shortage problems had not arisen. Social capital, defined as the value of institutions as factor of production, plays a crucial role to Simon, who stresses that political and economic freedom is more important than culture and history. However, Simon's ultimate resource – human imagination acting together with educated skills in a free society – is essentially what economic personalism calls the creative subjectivity of the human person. As a conscious, free, and creative being, the human person possesses dignity that the person realizes through human action aimed at meeting human needs, from which morality and markets evolve in a free society, where the morality of a culture determines the morality of its markets (Santelli et al., 2002). Judeo-Christian culture highlights the creative subjectivity of the human person (Felice, 2001). Transition into a free-market society is a cultural issue concerned with the change in individual perceptions, preferences, and attitudes (Colombatto, 2001). As Bauer (2000) stresses, economic performance depends on people's aptitudes, attitudes, motivations, and social and political institutions. Hence, in order to understand why solutions are eventually found in a free exchange society, one has to study its cultural foundations.

In particular, one must understand the evolution of the rules of just conduct and the grown, spontaneous order. Hayek (1973) makes a distinction between the made order, *taxis*, and the grown order, *kosmos*, where each order is governed by its specific rules: the former by rules of organization, *thesis*, and the latter by rules of just conduct, *nomos*. Between

Hayek's two types of rules, Simon seems to prefer rules of organization to rules of just conduct. However, the latter are spontaneously evolved norms that are crucial in the Great Society, i.e. the free exchange society. Boulding's (1978) evolutionary interpretation of history stresses the long, slow growth of knowledge, technology, and organization as the dominating dynamic, where production is an outcome of the use of the factors of production: knowledge, energy, and materials, while bonding is a product of the social organizers: threat, integration, and exchange. In particular, Boulding argues that benevolent integrative identification tends to initiate exchange and that integrative structures are necessary to sustain exchange. This puts moral culture at the very core of society.

Adam Smith's (1759) concept of fellow-feeling may be very helpful. As Sugden (2005) points out, Smith explains morality as emergent property of interaction among individuals, an emerging complex order where the impartial spectator represents conscience. Similarly, Rizvi (2002) argues that Smith's impartial spectator inside each person provides normative faculties, a set of preferences used to decide among other preferences, thus putting a check on excessive self-interest, and elaborates the mechanisms by which morality emerges out of interpersonal relations. Hence, morality is a complex order that emerges through social interaction. Kolm (2005) considers the pro-social act of gift giving, which depends on reciprocity, as conditional altruism, and he argues that reciprocal and replicating behavior can secure efficient relations and more generally remedy market failures and government failures.

Reciprocity is crucial to human cooperation in the form of innovative exchange, while culture may include norms that create reciprocal sympathy among members of a community or society. Boulding (1973) finds reciprocity - mutual grants (mutual one-way transfers) that have integrative aspects - to be the source of exchange (two-way transfers), which is formalization of reciprocity through contracts, but lacks the integrative aspects of reciprocity. Hume (1777) views sympathy as an expression of social affections, compassion for which humans have a sweet, natural, and virtuous propensity, and praises the harmony of minds and a friendship based on mutual esteem and gratitude. Smith (1759) considers humans to have the dispositions of fellow-feeling and correspondence of sentiments. Sugden (2005) points out that Smith represents the formation of morality as a social process in which individual sentiments are brought into alignment. Using Adam Smith's concept of fellow-feeling to study interacting individual affections, Sugden argues that interpersonal relations are essential to the evolution of normative standards, as they endow corresponding sentiments with normative status, thus maintaining trust and reciprocity. Consequently, a culture may through its norms yield reciprocal sympathy, understood as compassion through mutual grants, and thereby constitute social capital by shaping institutions.

The cultural norms behind reciprocal sympathy reflect attitudes, inclinations, and dispositions that facilitate social cooperation, thus being consistent with Yeager's (2001) indirect utilitarianism, which harmonizes the general interest with the considered, long run self-interest. In this context, self-worth plays an important role. Referring to Smith (1759), Hargreaves Heap (2005) points out that self-worth depends on the mutual validation of ends, achieved through interpersonal relations, thus being different from ordinary preferences. Therefore, the value of the ultimate resource depends on social interaction.

Learning is the result of such social interaction. Simon (1996) argues that the stock of useful knowledge increases with population size and growth, but referring to Hume's (1777) explanation why China fell behind Europe, Simon stresses that a large population is not enough. According to Hume, a free government is essential to knowledge creation, because

law gives the security required for experimentation, and by stopping the progress of authority as well as that of power, a number of neighboring and independent small states is the most favorable condition for learning. As case in point, the Baltic Sea Area may facilitate learning as a source of economic progress, especially for the smaller Baltic (Estonia, Latvia, and Lithuania) and Nordic (Denmark, Finland, Norway, and Sweden)¹ member countries. Within the global economy, Marmefelt (2007) argues that economic integration between neighboring emerging market economies and market economies may improve global competitiveness. He compares civil society in Lithuania and Sweden, and finds that the ethical standard ranges are not consistent with each other and that the intangible hand is much softer in Lithuania than in Sweden, thus reflecting the formative stage of Lithuania's civil society.

This chapter argues that it is necessary to study the cultural foundations of a free exchange society in order to understand why solutions to resource shortages are eventually found in such a society. The purpose is to study how cultural differences in reciprocal sympathy between the emerging exchange society Lithuania and the exchange society Sweden constrain the potential to learning through economic integration within the Baltic Sea Area in the form of Baltic-Nordic learning networks, given that learning to overcome resource scarcities through economic integration within the Baltic Sea Area in the form of Baltic-Nordic learning networks would require that Baltic and Nordic cultures yield the same strength of reciprocal sympathy.

Using Boulding's (1978) evolutionary framework, learning changes technology and organization, pushing back the limits set by natural resources, but learning depends itself upon the parallel development of technology and organization, where organization is an outcome of the bonding structure – the combination of the three social organizers. Hence, bonding shapes technological and organizational competencies. This chapter deals with the historical-cultural conditioning of bonding and thereby of competencies. It defines a culture of strong reciprocal sympathy as a culture characterized by compassion through mutual grants that constitutes a fellow-feeling that yields what Giddens (1990) calls trust in abstract systems in the form of faceless commitments. As Schelling (1960) argues, culture constitutes a powerful focal principle. Using a historical-anthropological-interpretive approach, culture provides social capital by improving the efficiency of resource utilization under economic freedom. Section 2 develops a correlated evolutionary game to analyze how the culture influences the probability of finding a solution to resource scarcity problems through innovation. Turning to Lithuania and Sweden, section 3 analyzes the approach to achieve human dignity and section 4 analyzes culture as social capital, while section 5 studies social capital and climate efficient human development. Section 6 gives the conclusions. Finally, the appendix provides the mathematics of the correlated evolutionary game developed in section 2.

¹ Iceland is also a Nordic country, but situated in the middle of the Atlantic, it is not considered as a Baltic Sea Area member, which presumes some geographic proximity.

2. CULTURE AND THE EVOLUTION OF INNOVATIVE EXCHANGE

Austrian economics acknowledges that the knowledge of the individual trader in a free market is incomplete. Traders possess local knowledge and benefit from the local knowledge of other traders through price signals. Prices will be correct only in equilibrium, using Hayek's (1937, 1948) definition, meaning that the plans of traders have to be mutually compatible and individual subjective sets of data of the traders (facts known to the individuals traders), which are reflected in individual plans, have to correspond to the objective data (real facts). This means a correspondence between common expectations and objective data. Following Hayek (1945, 1948), the problem is to secure the best use of resources known to any members of society for ends whose relative importance only these individuals know, especially because of the great importance of the knowledge of the particular circumstances of time and place. Dispersed knowledge of the relevant facts implies that prices can coordinate the separate actions of different people (Hayek, 1945, 1948). In the market order, catallaxy, there is a wealth-creating "game of catallaxy", in which competition operates as a discovery procedure by giving possibilities to exploit circumstances profitably and by conveying to other parties the information that there is such an opportunity (Hayek, 1976). The market order has a great advantage in using dispersed knowledge, while communication through money prices give a positive-sum game as market prices coordinate separate actions of different people.

However, civilization evolves spontaneously through the submission to new rules of conduct and the exchange society and coordination through the market process depend upon gradually evolved moral beliefs (Hayek, 1979). The exchange system is based upon the integrative system, since exchange requires a small amount of benevolence (Boulding, 1978). According to Santelli et al. (2002), the human person achieves self-realization through participation, while the moral and cultural institutions of society induce the free market to be a moral instrument for human development. Schultz (2001) shows formally that moral normative constraints are necessary conditions of Pareto-optimal equilibrium allocations of commodities achieved through market interaction. These moral normative constraints emerge from small-group interaction within civil society, whose core institution is the family. Integrative structures are spontaneously organized within the civil society that provides the foundation of a market order and democratic capitalism through a moral culture that generates mutual trust.

The foundation of today's large societies is rule-coordinated social action, so the market order requires a civil society that provides a moral culture that includes preferences for honest dealings, playing by the rules, peace, and voluntary interaction. As Hayek (1979) argues, coordination of larger groups than hunting and gathering bands requires a cultural evolution of learnt rules. Using Heyne's (1985) notion of rule-coordinated society founded upon moral rules nurtured in personal societies, civil society gives the personal elements that nurture the moral rules upon which rule-coordinated capitalist societies are founded. For Santelli et al. (2002), community is a unity of persons in a common culture and they consider the small-group order essential to promote self-interest, while avoiding selfishness, thus pointing at the connection between civil society and moral culture.

In free exchange societies that are characterized by a strong civil society, the integrative and exchange systems are strong compared with the threat system, referring to Boulding's

(1978) organizers of society. Referring to Shionoya's (2005) ethics of competition, morality is embedded in market competition, meaning that entrepreneurs seek excellence through innovation, while ethical values regulate the market. In his axiology of the welfare state, Shionoya defines culture as the totality of activities based upon human interests and their outcomes without presupposing several abstract higher values, and points out that morality embodies social norms that enable individuals in a society to survive and coexist. He gives supreme status to moral values, because they derive from the most basic interest: social coexistence.

The indirect utilitarian framework, as outlined by Yeager (2001), focuses upon the attitudes, inclinations, and dispositions to social cooperation. The broader notion of self-interest of Yeager's indirect utilitarianism, which is an extension of rules utilitarianism, may include transcendence, unlike the narrow self-interest of acts utilitarianism. Religion may create these attitudes, inclinations, and dispositions to follow moral rules, which in turn contribute to social cooperation. Economic personalism combines Christian social ethics and free-market economics to supplement economics with a system of morality for the marketplace (Santelli et al., 2002). As its theoretical and methodological foundations, Beabout et al. (2002) outlines a new praxeology with ontological and positive as well as negative freedom, i.e. self-governance and freedom to meet positive obligations as well as freedom from coercion. Mises's (1949) praxeology, whose core consists of individuals acting to substitute less satisfactory states with more satisfactory ones, based upon negative freedom, is combined with Wojtyla's (1979) focus upon intersubjectivity and participation, thus uniting transcendence and self-interest, based upon ontological and positive as well as negative freedom. Beabout et al. point out that to Wojtyla, transcendence refers to the ability among individuals to go beyond their own intentionality, making the self act in truth, while the dignity of the human person is best defended with a free polity, free markets, and a free culture.

However, one may argue that a broad notion of self-interest incorporates transcendence into an indirect utilitarian framework. Yeager's (2001) indirect utilitarianism, which involves a broader notion of self-interest, is an extension of rules utilitarianism that goes beyond the narrow self-interest of acts utilitarianism, which corresponds to selfishness. Virtues evolve, because they are beneficial to social cooperation, and they reflect attitudes, inclinations, and dispositions. As Hayek (1973) argues, the rules of just conduct are observed, because they give the group superior strength, not because the acting person is aware of them. Esteem and self-esteem are important elements behind the viability of virtues.

Brennan and Pettit (2004) develop the economy of esteem, where the intangible hand is the engine that drives civil society, by using the forces of esteem to enforce virtues. However, they use a narrow notion of esteem that excludes self-esteem, which is the most important form of esteem, and neglects that the weight we attribute to esteem from others increases with their proximity to us. Achievement of excellence is crucial to self-esteem. Following Shionoya (2005), a person's valuation of own accomplishment of the duties of personal perfection is crucial to gain self-esteem. The impartial spectator's approval is essential to praiseworthiness, as humans have a desire to deserve, and not just to receive, praise (Pelligra, 2005). The intangible hand may enforce attitudes, inclinations, and dispositions to social cooperation, because moral and religious ideas, as reflected in human values and beliefs, give meaning to esteem by establishing behavioral criteria for esteem and disesteem (Marmefelt,

2007). In Brennan and Pettit's (2004) three range model,² ideals are levels of aspiration that induce higher average performance, because people try to avoid disesteem.

The notion of the humane economy of economic personalism puts the life and dignity of the human person at the core as evaluation criteria (Santelli et al., 2002). Economic personalism provides through participation a clear link between moral duty and civil society. According to Santelli et al., the small-group order of family, friends, church, and colleagues with whom one shares traditions, moral values, and plans for the future creates a difference between self-interest and selfishness, and each human person is called to achieve the perfection of his personhood by entering into genuine community. The intangible hand of civil society reconciles self-esteem with the esteem received from others, giving a heavy weight to customs and traditions.

As Shionoya (2005) argues, Hayek combines morality and economy by means of information, so the evolution of tradition and customs gives evolutionary rationalism. In the humane economy, personal freedom and responsibility are necessary conditions for human fulfillment, while human capital and human creativity are crucial components (Santelli et al., 2002). Hence, the intangible hand of civil society shapes the valuation of excellence. Since the small-group order of civil society creates a difference between self-interest and selfishness, morality is embedded in market competition. More generally, Boulding's (1978) three social organizers, the market institutionalizing the exchange system, the state institutionalizing the threat system, and civil society institutionalizing the integrative system, are all arenas of interaction and all have morality embedded in their interactions. Wagner (2007) regards state and market as two arenas of interaction, the public square and the market square, respectively, which together connect political enterprises and market enterprises established in these two squares in networks, as the two squares are open-access commons where people create enterprises. Wagner includes civil society in the market square, but from the perspective of the three social organizers, civil society constitutes a square of its own, the civic square, in which civic enterprises are created. Chang and Kozul-Wright's (1994) notion of national system of entrepreneurship consists of a set of institutions, which, on the one hand, encourages innovation and risk taking, but on the other hand, manages the destructive component of entrepreneurship. This notion goes beyond dichotomies of state vs. market, like Wagner's view of state and market as interconnected arenas of interaction. The national system of entrepreneurship consists of institutions of the civic, market, and political squares, and within the system, civic, market, and political enterprises are connected in networks.

The interactions between civic, market, and political entrepreneurs can be formalized as a correlated evolutionary Innovative Exchange game, where they, as innovative traders, interact through various combinations of integration, exchange, and threat, possibly establishing a price signaling system that makes them take the appropriate innovative action. Given the fundamental importance of integrative structures, which civil society provides, civic entrepreneurs connect market entrepreneurs, injecting morality into the market, and may connect political entrepreneurs with market entrepreneurs and other political entrepreneurs,

2 The three ranges are: (i) Standard performance: a weighted average of ideals and average performance, giving neither esteem nor disesteem; (ii) Above standard performance: giving esteem; (iii) Below standard performance: giving disesteem.

injecting morality into the state through civil society involvement in public policy making. A shared history of social interaction establishes shared meanings among the entrepreneurs.

The meanings of the signals evolve within a cultural context through a history of social interactions. Culture is a discursive process, in which new meanings are negotiated (Lavoie and Chamlee-Wright, 2000). Hence, cultural evolution may be seen as evolution of shared meanings. Skyrms (1996) analyzes the evolution of meaning among vervet monkeys through a correlated evolutionary Sender-Receiver game, where a signaling system, which represents the meanings attributed to signals, can be established through some degree of correlation, although signaling is costly. Innovative exchange is an evolutionary process, because bounded rationality, genuine uncertainty, and rule following characterize innovation, while correlation gives some degree of non-anonymous interaction, thus facilitating coordination. The innovative traders create heterogeneous capital combinations, which form the capital structure of the economy, along the lines of Lachmann (1956). Hence, they interact as sellers and buyers in non-random pairing games at various stages of the production process from natural resources to consumable output. Non-random pairing of traders makes learning from repeated interaction possible, thus decreasing the price deviations from the prices reflecting the true productive value of capital inputs. This means that a shared history of interaction provides the meaning of signals established.

The traders may take non-innovative action, $I0$, or any of the two innovative actions, $I1$ or $I2$. Hence, either an input is processed through the old capital combination of an individual trader or through any new capital combination of an individual trader, which in the latter case increases net output. Knowledge is dispersed and the knowledge of a particular trader may take two knowledge states, $K1$ and $K2$. The input prices, $P1$ and $P2$, reflect the knowledge states, $K1$ and $K2$, respectively.

In the correlated evolutionary Innovative Exchange game, a signaling system of innovative exchange may be established:

INNO: Send $P1$ if $K1$ and $P2$ if $K2$; Do $I1$ if $P1$ and $I2$ if $P2$

This is the innovative exchange convention, where the knowledge states are accurately represented in the price signals and the appropriate innovative action of selling outputs and buying inputs is taken in response to the price signal received. The failure to establish such a convention is represented by the state of nature convention, where state of nature refers to a state without a functioning signaling system of innovative exchange:

FAIL: Send $P1$ if $K1$ and $P2$ if $K2$; Do $I0$

In this convention, the knowledge states of innovation are accurately represented in the price signals, but non-innovative action is always taken. Hence, signals are correct, but are not recognized as such. The receivers do not know how to interpret them, so they take non-innovative action.

Now, consider a discrete production process of a finite number of Hicksian weeks, along the lines of Hicks (1973). During each week, several capital inputs are bought and combined to produce an output that is sold to several buyers, so each trader is initially buyer, then producer, and finally seller who achieves a weekly net output. Following Hicks, we may then calculate the value of capital invested *ex post*, i.e. cost measured, by turning the net output

profile of weekly net outputs into a net input profile. Capital invested is inversely related to the efficiency of capital. As innovation increases productivity, the net inputs will decrease, thus decreasing capital invested.

Put this into Simon's (1996) theory. When growth in both population and income create resource shortages, net inputs increase, thus increasing capital invested, but when solutions are eventually found in a free society through innovations, net inputs decrease, thus decreasing capital invested. Consequently, the innovative exchange convention yields decreasing capital invested, while the state of nature convention yields increasing capital invested when the resource shortage occurs. The payoffs of the innovative exchange convention are, thus, always higher than the payoffs of the state of nature convention, whose payoffs also decrease when resource shortages occur.

When two non-randomly paired traders play INNO, let $\alpha > 1$ and $\beta > 1$ denote the payoffs of the seller and the buyer, respectively. When both play FAIL, set their payoffs to unity before the resource shortage occurred and let $0 < \gamma < 1$ and $0 < \delta < 1$ be the payoffs of the seller and the buyer, respectively, after the resource shortage has occurred, thus implying a cost to traders, unless an innovative solution is realized that overcomes the resource shortage. Since knowledge about the productive value of a capital input is incomplete, the price paid for the input, the actual exchange price, may deviate from the price reflecting its productive value by some small ε , which represents what Boulding (1973) calls an implicit grant, here as redistribution between seller and buyer due to ignorance. There is an implicit grant from buyer to seller when $\varepsilon > 0$ and from seller to buyer when $\varepsilon < 0$. Learning from repeated interaction decreases this price deviation, where innovative exchange provides knowledge about new capital combinations that are used to solve resource shortages.

Let α^* , β^* , γ^* , and δ^* denote the payoffs when the exchange price correctly reflects the productive value of the capital input. Hence, when both play INNO, $\alpha = \alpha^* + \varepsilon$ and $\beta = \beta^* - \varepsilon$. Furthermore, innovative action is more costly than non-innovative action, but is more beneficial the greater the resource shortage. However, innovative exchange involves transaction costs. The net cost of innovative exchange decreases the greater the resource shortage, because failure to establish innovative exchange becomes more costly. Let the relative transaction costs, therefore, be equal to γ^* and δ^* , respectively.

Culture provides a level of reciprocal sympathy of a community, λ , along the lines of Sally (2001), that is the utility of two interacting agents includes, not only the own utility, but also the utility of the other agent in a reciprocal way. This is a way to introduce Adam Smith's notion of fellow-feeling into the individual utility function. The payoffs of the individual interaction reflect the general level of reciprocal sympathy of the culture, $0 < \lambda < 1$, if both play INNO, otherwise $\lambda = 0$. Hence, learning gives value to reciprocal sympathy through innovative exchange, because it yields solutions to resource shortages. This can be seen as conditional altruism in the sense that fellow-feeling is conditioned on the fellow human contributing to an innovative solution to a resource shortage problem. Withheld sympathy is a punishment for not contributing. The failure to contribute is in itself a lack of sympathy, which is reciprocated. The level of reciprocal sympathy, which has been established through historical-cultural conditioning, is thus activated when both traders contribute. Hence, reciprocal sympathy increases the payoffs only in the innovative exchange convention. Rather than having Kolm's (2005) dichotomy between 'giving' and 'keeping', this model has a continuum of 'giving', i.e. contributing to an innovative solution, from

something up to almost everything, $0 < \lambda < 1$, when both play innovative exchange. Figure 1 gives the payoff matrix of the Innovative Exchange game.

		Buyer	
		INNO	FAIL
Seller	INNO	$\alpha + \lambda\beta - \gamma^*, \beta + \lambda\alpha - \delta^*$	ε, δ
	FAIL	$\gamma, -\varepsilon$	γ, δ

Figure 1 The Innovative Exchange game.

The implicit grant decreases with the level of reciprocal sympathy a culture possesses, because correlation decreases the implicit grant through learning from repeated interaction. Hence, more accurate price signals can emerge. Since reciprocal sympathy increases the probability of repeated interaction, correlation becomes stronger in a culture with stronger reciprocal sympathy. This gives a stronger inclination to reduce the implicit grant, thus yielding a more correct price.

The evolution of innovative exchange follows Malthusian dynamics, also called replicator dynamics, where the growth rate of a strategy is set equal to its relative fitness. This gives a system of two differential equations for the growth of innovative sellers and buyers, respectively. In order to analyze the probability that innovative exchange evolves, the evolutionary equilibria have to be identified. Following Friedman (1991, 1998), evolutionary equilibria may be identified through a local stability analysis of the Jacobian of the system two differential equations. Skyrms (1996) calls an attracting equilibrium in non-random pairing games an adaptive ratifiable strategy. A local stability analysis identifies the two adaptive ratifiable strategies of the Innovative Exchange game, which are its two conventions:

- i) Innovative exchange convention: All traders play INNO.
- ii) State of nature convention: All traders play FAIL.

A saddle point separates the basins of attraction of these two conventions. When the payoffs of INNO increase relative to those of FAIL, the saddle point moves towards the state of nature convention (FAIL, FAIL), thus increasing the basin of attraction of the innovative exchange convention (INNO, INNO) and thereby the probability that it evolves.

When a resource shortage occurs, the productive value of existing capital combinations decreases, because the resource shortage implies a cost. This decreases relative transaction costs of innovative exchange, γ^* and δ^* , thus increasing the payoffs of INNO, but this means also a decrease of the payoffs of FAIL. The relative value of innovative exchange thus increases. Hence, the probability that the innovative exchange convention evolves increases. Now, consider culture. A stronger reciprocal sympathy increases the payoff of INNO through a greater concern for the interests of the other trader, regardless of the incentives that resource shortages provide. A functioning signaling system of innovative exchange becomes more valuable when a resource shortage problem has occurred, because innovation becomes more valuable. Depending on the morality that emerges through social interaction, i.e. interpersonal relations, the evolution of the innovative exchange convention is facilitated. This morality

reflects fellow-feeling and correspondence of sentiments, here represented as reciprocal sympathy. Consequently, innovative exchange is more likely to evolve in cultures of strong reciprocal sympathy than in cultures of weak reciprocal sympathy. First, cultures of strong reciprocal sympathy are characterized by an understanding among traders that the other needs to benefit from an exchange if it is going to take place. Second, this understanding gives a greater propensity to become involved in repeated interaction, thus increasing learning-by-trading and thereby the probability that innovative traders interact with each other.

3. THE APPROACH TO ACHIEVE HUMAN DIGNITY IN LITHUANIA AND SWEDEN

The Baltic Sea Area may be seen as a group of independent states, connected by commerce and policy that, along the lines of Hume (1777), creates the most favorable conditions to the rise of politeness and learning. Hume stresses that a division of small states is favorable to learning, because it stops the progress of authority and power. Among the Baltic Sea Area members, there are three large states: Russia, Germany, and Poland, but the remaining seven, its four Nordic members: Denmark, Finland, Norway, and Sweden, and its three Baltic members: Estonia, Latvia, and Lithuania, do classify as small or medium-sized states. Nordic-Baltic cooperation may, therefore, from a Humean viewpoint be of most interest. Lithuania and Sweden are neighboring states that may improve learning through innovative exchange. In the late 1990s, Sweden became a major foreign investor in Lithuania (OECD, 2001), which represents a post-socialist revival of Lithuania's pre-socialist economic relations with Sweden. Rauch (1974) points out that during the interwar period Sweden invested considerable amounts in Lithuania, and Marmefelt (2007) finds that during the 1999-2003 period Sweden became Lithuania's largest Nordic trading partner. However, among Lithuanian IT service providers by 2004, Marmefelt observes that learning links were important, but those formed were Lithuanian-Indian, Lithuanian-Finnish, or Lithuanian-Swedish, depending on technological complementarities and common market interests as well as age and size of the Lithuanian firm. The morality of markets was not shared, because the ethical standard ranges in Lithuania and Sweden were not consistent with each other, while the intangible hand was much softer in Lithuania than in Sweden (Marmefelt, 2007).

Considering Baltic-Nordic learning networks, the Baltic emerging market economy Lithuania and the Nordic market economy Sweden provide historically specific cases, in terms of the approach to achieve human dignity, the ultimate goal of human development. The approach is an emergent order that reflects the patterns of interactions between civic, market, and political entrepreneurs, in particular how civic entrepreneurs connect market and political entrepreneurs.

Both Lithuania and Sweden belong to the Baltic Sea Area, which is characterized by increasingly intensive integration. In addition, Catholic, ex-communist Lithuania is a new Eastern member of the European Union, while Lutheran Sweden is an older Western member. According to Inglehart et al. (2004), Protestant Europe has both stronger self-expression values and secular-rational values - Sweden having the highest score on self-expression values and being second only to Japan on secular-rational values - than Catholic Europe, while ex-communist Europe combines survival values with secular-rational values - Lithuania

having rather strong survival values, but secular-rational values in the range of Protestant Europe. How does this difference along the survival vs. self-expression value scale influence the method of achieving human dignity?

The notion of the humane economy puts the life and dignity of the human person at the core as evaluation criteria and considers personal freedom and responsibility as necessary conditions for human fulfillment with human capital and human creativity as crucial components (Santelli et al., 2002). In the humane economy, self-expression values would be beneficial to human fulfillment, because they open up for morality. Using data from the 1999-2001 European Values Study and World Values Surveys (Inglehart et al., 2004), we may develop a civil society participation index, based upon the share belonging to voluntary associations and activities and doing unpaid labor there, liberal values, and fellow-feeling, using the notion of the humane economy, where freedom is essential. In other words, spontaneous interpersonal cooperation among humans is included in civil society as well as non-governmental organizations, because civil society is not limited to the latter. For each variable the maximum is 10 and the minimum is 0, while indices are the average value of its variables.

Organization is the relative share belonging to voluntary associations and activities, while labor grants is the relative share doing unpaid work to them. Unpaid labor is a grant, which Boulding (1973) defines as a one-way transfer. The crucial role of personal freedom and responsibility implies liberal values, stressing freedom and competition, in combination with fellow-feeling, stressing compassion and preparedness to help fellow humans. Hence, civil society goes beyond voluntary associations and activities, which are made orders, *taxis*, and includes grown orders, *kosmos*, referring to Hayek (1973). Liberal values includes freedom being more important than equality, competition being good, the state giving more freedom to firms, people taking more responsibility for themselves, respect for individual human rights, compatibility between democracy and economic efficiency, and aversion to a strong leader. Fellow-feeling expresses the preparedness to help family, neighbors, elderly, immigrants, and sick and disabled.

Table 1 shows that organization, labor grants, liberal values, and fellow-feeling all contributed to yield a lower civil society participation index in Lithuania than in Sweden. Active participation is measured through labor grants (*taxis*) and fellow-feeling (*kosmos*). Spontaneous order participation was relatively much weaker than organized participation in Lithuania than in Sweden. Spontaneous order participation requires a moral culture that creates trust in people when freedom is perceived to be high. In addition, trust in people should be accompanied by participativeness at work and in society to account for a desire for perfection of personhood by entering into genuine community.

Participativeness at work means a desire for a job that meets one's abilities, is interesting, allows oneself to achieve something, take initiative, and be useful to society, while participativeness in society means a desire for a stronger emphasis on individual and family and a weaker one on money and work, and a desire for a simpler and natural life style.

The first considers a desire to achieve genuine community through the firm or workplace, while the latter means a stronger emphasis on human fulfillment rather than on working to make money. In any case, participativeness reflects individual preferences, what they would do if institutions were the right ones. A moral culture, whose norms yield a high level of trust under a high level of perceived freedom, is a prerequisite for such participativeness to be put

into action. Perceived freedom and trust in people refer to a great deal of perceived freedom, and an inclination to trust most people, respectively.

Table 1. Civil society participation in Lithuania and Sweden

	<i>Participation</i>	Organization	Labor grants	Liberal values	Fellow-feeling
Lithuania	2.0	0.3	0.4	4.2	3.1
Sweden	6.2	5.3	2.9	7.0	9.8

Source: Inglehart et al. (2004).

Note: Organization is the relative share belonging to voluntary associations and activities, while labor grants is the relative share doing unpaid work to them. Liberal values includes freedom being more important than equality, competition being good, the state giving more freedom to firms, people taking more responsibility for themselves, respect for individual human rights, compatibility between democracy and economic efficiency, and aversion to a strong leader. Fellow-feeling expresses the preparedness to help family, neighbors, elderly, immigrants, and sick and disabled.

Table 2. Participativeness, perceived freedom and trust in Lithuania and Sweden

	Participativeness at work	Participativeness in society	Perceived freedom	Trust in people
Lithuania	3.0	5.9	5.4	3.4
Sweden	4.3	6.5	8.8	9.8

Source: Inglehart et al. (2004).

Note: Participativeness at work means a desire for a job that meets one's abilities, is interesting, allows one self to achieve something, take initiative, and be useful to society, while participativeness in society means a desire for a stronger emphasis on individual and family and a weaker one on money and work, and a desire for a simpler and natural life style. Perceived freedom and trust in people refer to a great deal of perceived freedom, and an inclination to trust most people, respectively.

Table 2 shows somewhat lower levels of participativeness in Lithuania than in Sweden, while Lithuania's levels of perceived freedom and trust in people were much lower. The latter can be explained by the weakness of Lithuanian civil society, hardly going beyond the family, while the former reflect Lithuania's survival values in contrast to Sweden's self-expression values, as working to make money rather than to achieve something is much more essential to Lithuanians.³ Hence, Lithuanian participativeness in terms of achievements was very limited and restricted very much to the family.

Summing-up, at the turn of the millennium, civil society participation was lower in Lithuania than in Sweden, because both cooperation through spontaneous interpersonal relations (liberal values and fellow-feeling) and non-governmental organizations (organization and labor grants) were weaker, while spontaneous order participation was more restricted due to a moral culture less able to sustain high trust together with high perceived

³ The desire for less emphasis on money was 3.8 for Lithuania and 7.5 for Sweden and less emphasis on work was 1.7 for Lithuania and 7.8 in Sweden, while the desire for more emphasis on family was 9.4 in Lithuania and 3.2 in Sweden. A job that allows the individual to achieve something was 1.7 in Lithuania and 6.5 in Sweden.

freedom, although participativeness, the desire to participate, was only somewhat lower. The approach to achieve human dignity was less based upon civil society participation in general and spontaneous order participation in particular due to the moral culture, thus suggesting that civic entrepreneurs connected market and political entrepreneurs to a lesser extent in Lithuania than in Sweden.

4. CULTURE AS SOCIAL CAPITAL IN LITHUANIA AND SWEDEN

Moral culture can be classified according to the strength of reciprocal sympathy it creates through its norms. Social interactions in civil society yield morality as emergent order, thus defining the role of civic entrepreneurs, but the value of civic entrepreneurship also depends on the moral culture. The correlated evolutionary Innovative Exchange game above shows that a culture of strong reciprocal sympathy yields a high probability that innovative exchange evolves. The reason is that reciprocal sympathy sustains an order based upon economic freedom, private property, diversity, and competition.

Human imagination acting together with educated skills in a free society, i.e. Simon's ultimate resource, depends upon social interactions. In order to form images of large, complex, and integrated systems unknown from personal experience, which are of great importance in the genesis of human artifacts, humans need to communicate by means of language (Boulding, 1978). Similarly, in order to benefit from dispersed knowledge, humans need to communicate information by means of the price system, which is necessary to sustain a complex society with extensive division of labor (Hayek, 1945, 1948). The price mechanism and language rely on exit and voice, respectively, to communicate knowledge of insufficient economic performance, but voice allows communication of organizational and technological knowledge that may improve economic performance (Marmefelt, 2007). Hence, both the price system and language can communicate knowledge about a resource scarcity, while language may communicate knowledge that may help overcoming that resource scarcity. All communication, however, involves social interactions, while reciprocal sympathy increases the probability of repeated interaction, thus contributing to a more correct valuation. Human imagination will thereby be more likely to proceed along more fruitful conjectures. It can, thus, be seen as ultimately constrained by the norms provided by the culture. In a free society human behavior is constrained by the moral norms of its culture.

Culture is a belief system and, following Commons (1899-1900), beliefs provide the persuasive component of institutions. According to Boulding (1978), integrative power includes aspects, such as role power, symbolic power, community power, and moral power, where professed moral ideals evolve as part of the larger dynamic of symbolic and persuasive systems. Essentially, culture provides the morality of social interaction in market, civil society, and state that allow human creativity to flourish. As Serageldin and Grootaert (2000) point out, social capital, which is generally recognized as necessary to a functioning social order, involves internal coherence, common cultural identifications, a sense of belonging, and shared behavioral norms. In their view, shared values and norms, and mutual trust are key measures of interaction between micro and macro institutions. They find that the transition economies in Eastern Europe suffer from absence of interaction between the micro and macro levels of social capital with networks at the base and the top without links in between them

and a general distrust of the elite. This means that civic entrepreneurs are missing, so that market entrepreneurs and political entrepreneurs are only linked within the *nomenklatura* for rent-seeking purposes.

Networks will be more viable when sustained by cultural norms, because social capital has a cognitive dimension (culture) and a structural dimension (formal rules), which are mutually reinforcing (Krishna, 2000). Structural social capital, such as roles, rules, precedents, procedures, and networks, facilitates mutually beneficial collective action, while cognitive social capital, such as norms, values, attitudes, and beliefs, predisposes people toward mutually beneficial collective action (Uphoff, 2000). In other words, culture has a value as cognitive social capital, while institutions have a value as structural social capital.

History and early socialization influence whether people behave like friends with positively interdependent utility functions, enemies with negatively interdependent utility functions, or strangers with independent utility functions (Uphoff, 2000). A culture of strong reciprocal sympathy induces traders to behave like friends, whose positive-sum interaction yields a high probability that innovative exchange evolves, involving civic, market, and political entrepreneurs. However, such a culture is an outcome of history.

In anti-modern societies characterized by organizational failure, such as Russia, social capital in the form of networks is situational rather than cultural, Rose (2000) points out. Yet, situational networks are outcomes of a historically evolved anti-modern, rent-seeking culture. In case of bank-industry networks, the post-socialist Lithuanian holding evolved with a rent-seeking function, in contrast to the Swedish ownership sphere that had evolved with a learning-by-financing function, because of the Lithuanian post-socialist combination of an undeveloped banking, a weak network commitment, and a resilient *nomenklatura* (Marmefelt, 2004). Using Uphoff's (2000) continuum of social capital, the functional difference between the Lithuanian holding and the Swedish ownership sphere, as institutions, suggests that Lithuanian social capital was elementary and Swedish social capital was substantial, implying that, for historical reasons, Lithuanian traders tend to behave like strangers with interest primary in their own welfare, while Swedish traders tend to behave like friends with commitment to common enterprises.

In order to substantiate this hypothesis through a historical-anthropological-interpretive approach, one must address how history shapes culture. Chamlee-Wright (1997) argues that economists should be more like anthropologists and develop an interpretive approach, thus gaining access to the life-world of complex meanings in which people operate. Similarly, Lavoie and Chamlee-Wright (2000) argue for ethnography and archival-historical research, which involve very close-up studies of complex details in their specific contexts. This approach, however, is more suitable for comparative statics, interpreting the complex meanings of some selected historical epoch or epochs with today.

For a genealogy of institutions one must study dynamics, starting from today and then going backwards in history to identify the broad lines of cultural evolution. What matters is how members of a society perceive their shared history rather than the actual history. The cultural heritage consists of a complex of rules of conduct, which prevailed because they made people more successful (Hayek, 1973). Hence, today it is possible to perceive what rules contributed to success in the past, and the focus should be on present meanings of the past rather than on past contemporary meanings. Historiography, in order to outline a historical synthesis may be appropriate, in the sense of studying the interpretations of past events made by present historians, which gives an understanding of present meanings of a

shared history. The historical synthesis outlined here is based upon Hayek's (1952) and Searle's (1999) theories of the mind. After all, culture exists within interacting human minds.

Referring to Hayek's (1952) mental order of sensations, culture can be seen as a shared map or classification system, which is created by past experience and guides the associative processes of the individuals belonging to that culture, thus giving the representations of individual events their meaning. In other words, culture is its history, where the associative processes are formed. The mechanisms can be explained in terms of consciousness and intentionality, along the lines of Searle (1999), who provides some useful insights:

- i) Consciousness is a unified field from the start: Consciousness is subjective states of awareness and the flux of our conscious experiences is seen as shifts and changes in the structure of the field.
- ii) Intentionality relates the individual to the rest of the world: Subjective brain states establish a link between intentionality and consciousness, where intentionality is a representation of objects and states of affairs in the world.
- iii) Intentionality depends on culture: Intentionality's background is both the deep background common to all cultures and local cultural practices that vary from culture to culture.
- iv) Intentionality explains institutions: Collective intentionality yields social facts and the symbolizing feature of language turns social facts into institutional facts.
- v) Language is the fundamental institution: Meaning is derived intentionality and language provides the basis for other institutions through symbols.

Ethnography and hermeneutics teach us that rational choice depends on the particular cultural context where it is made, while history teaches us about the characteristics of the cultural context at issue. The historical-anthropological-interpretive approach adopted in this chapter develops a genealogy of institutions, regarding culture as a shared unified field of consciousness, whose structure is given by a shared history, thus corresponding to Hayek's mental map.

Searle's (1999) views of meaning as derived intentionality and language as the fundamental institution shed light on Lavoie's and Chamlee-Wright's (2000) views of culture as the level of meaning underneath social action and the interpretative framework upon which institutions depend. As meaning is a form of derived intentionality that varies with local cultural practices, culture is the foundation of the symbolizing features of language, upon which societal institutions, other than language, build. By studying culture as the shared unified field of consciousness, the institutions of a society can be explained genealogically, as a shared perceived history, where the representation of historical events is at issue. The intentional state has to be identified in order to assess the shared unified field of consciousness.

Let us start investigating the shared unified field of consciousness in Lithuania and Sweden, respectively, from today's perspective and then look backwards. Economic freedom can be assessed through the Fraser Institute's Economic Freedom in the World index (EFW). Its components reflect what Hayek (1973) calls *nomos*, rules of just conduct, as well as *thesis*, rules of organization, the former being cognitive social capital, as norms, and the latter structural social capital, as legislation. If we compare the Economic Freedom in the World index with Transparency International's Corruption Perception index (CPI), then the

emergence of *nomos* – cultural norms, as rules of just conduct – in free societies becomes apparent, i.e. morality requires freedom. In a free society, a culture of strong reciprocal sympathy may evolve. The CPI measures the extent to which a society is anti-modern in Rose's (2000) sense, thus reflecting a culture of weak reciprocal sympathy with situational networks rather than networks of voluntary associations.

Table 3. Corruption perception and economic freedom in the Baltic Sea Area (Countries ordered according to Corruption Perception Index rank 2005)

Country(rank)	Corruption Perception Index				Economic Freedom Index ¹			
	1999	2001	2003	2005	1995	2001	2003	2005
<i>Finland</i> (2)	9.8	9.9	9.7	9.6	7.56	7.68	7.62	7.82
<i>Denmark</i> (4)	10.0	9.5	9.5	9.5	7.46	7.59	7.61	7.75
<i>Sweden</i> (6)	9.4	9.0	9.3	9.2	7.18	7.15	7.51	7.43
<i>Norway</i> (8)	8.9	8.6	8.8	8.9	7.44	7.13	7.27	7.38
<i>Germany</i> (16)	8.0	7.4	7.7	8.2	7.50	7.30	7.42	7.69
<i>Estonia</i> (27)	5.7	5.6	5.5	6.4	5.43	7.43	7.57	7.75
<i>Lithuania</i> (44)	3.8	4.8	4.7	4.8	4.84	6.32	6.65	7.25
<i>Latvia</i> (51)	3.4	3.4	3.8	4.2	4.84	6.75	6.79	7.30
<i>Poland</i> (70)	4.2	4.1	3.6	3.4	5.30	6.14	6.19	6.83
<i>Russia</i> (126)	2.4	2.3	2.7	2.4	4.09	4.85	5.15	5.54
<i>Average</i>	6.6	6.5	6.5	6.7	6.16	6.83	6.98	7.27
<i>Variance</i>	8.8	7.6	7.6	7.7	1.91	0.75	0.65	0.46

Sources: Transparency International, Corruption Perceptions Index 1999, 2001, 2003, and 2005 (<http://www.transparency.org>); and Gwartney, and Lawson (2007).

Note: 1. Chain-weighted summary index, allowing comparison over time.

Table 3 shows that in the Baltic Sea Area, economic freedom increased considerably in the three Baltic countries during the 1995-2005 period, while corruption remained rather stable during the 1999-2005 period. The EFW variance was lower and decreased faster than the CPI variance, which indicates a greater convergence in economic freedom than in morality of social interactions in civil society, market, and state.⁴

Table 4 shows that the overall difference in economic freedom between Lithuania and Sweden has decreased during the 1995-2005 period. By 2005, the economic freedom of Lithuania had converged to that of Sweden, and the only substantial differences were in legal structure and security of property rights, where Sweden maintained an advantage, but somewhat smaller, and the size of government, where Lithuania's advantage had increased. Sweden's earlier large advantage in the access to sound money had virtually disappeared,

4 There was a strong positive correlation between EFW and CPI in the Baltic Sea Area; strongest for EFW in 1995 and weakest for EFW in 2005 with CPI in 1999, 2001, 2003, and 2005, but the correlation became stronger for EFW in 2001, 2003, and 2005 with CPI in 2005, thus suggesting that morality, as the dual of corruption, grows in a free society, to which it also contributes.

	CPI1999	CPI2001	CPI2003	CPI2005
EFW1995	0.97	0.96	0.96	0.95
EFW2001	0.81	0.82	0.80	0.86
EFW2003	0.82	0.83	0.82	0.88
EFW2005	0.69	0.72	0.70	0.76

while Sweden maintained a small advantage in freedom to exchange with foreigners, but her advantage in regulation of credit, labor, and business turned into a small advantage to Lithuania.

Table 4. Components of economic freedom in Lithuania and Sweden

	<i>Lithuania</i>		<i>Sweden</i>		<i>Difference</i>	
	1995	2005	1995	2005	1995	2005
EFW Summary Rating	4.9	7.5	7.2	7.5	2.3	0.0
Size of Government	4.2	6.8	2.6	4.2	-1.6	-2.6
Legal Structure and Security of Property	5.9	6.9	8.9	8.9	3.0	2.0
Access to Sound Money	1.8	8.9	9.5	9.7	7.7	0.8
Freedom to Exchange with Foreigners	8.2	7.5	8.5	7.7	0.3	0.2
Regulation of Credit, Labor and Business	4.5	7.5	6.4	7.0	1.9	-0.5

Source: Gwartney, and Lawson (2007).

Note: Economic freedom in the world rating difference between the more free country and the less free country in terms of EFW summary rating (a positive sign indicates a freedom advantage to Sweden and a negative sign a freedom advantage to Lithuania).

Lithuania's lower morality of social interactions, as reflected in a higher level of perceived corruption, can explain her relatively weaker legal structure and security of property rights. The legal structure and security of property rights are founded in *nomos* rather than *thesis*. As Lavoie and Chamlee-Wright (2000) argue, a legal system requires a generally accepted attitude about justice and a property rights system requires a commonly accepted notion of ownership. Post-socialist Lithuania seemingly has had weaker norms of justice and private property than Sweden.

The size of government, which pulls down Sweden's EFW summary rating, reflects the level of trust in the elite, thus being an outcome of her higher morality of social interactions. In Sweden, bureaucracy was formed as a central instrument for creating a new society based on the *folkhem* (home of the people) idea, which had been taken over by the Social Democrats from the Conservatives (Torstendahl, 1991, Stråth, 1996). As Stråth (1996) argues, the *folkhem* idea can be traced back to Swedish foundry culture, while coalitions between the king and the peasants against the nobility, and a Lutheran state church made the Swedish people positive toward a strong state.

The structure of the Lithuanian field of conscious is less smooth. The interwar period of independence functioned as a frame of reference when forming strategies to overcome the fundamental barriers to pluralistic democracy and market economy created during the Soviet period (Nørgaard and Johannsen, 1999). In Lithuania, there is a path-dependence of post-Soviet institutions upon pre-Soviet institutions (Marmefelt, 2004). The medieval Grand Duchy, created by Pagan rulers, and the Smetona regime were seen as the golden age during the Soviet regime (Vareikis, 1998). In the 1930s, Smetona had made Lithuania into an authoritarian one-party state, glorifying Lithuania's past and reviving the spirit of her great medieval period, establishing professional chambers and separating the Lithuanian state from the Roman Catholic Church (Rauch, 1974). Authoritarian nationalism destroyed the capacity

for spontaneous sociability already in interwar Lithuania, thus making post-socialist Lithuania into a low-trust society (Marmefelt, 2004). Consequently, historical events in the 1930s decreased the trust in the elite in Lithuania, in contrast to Sweden.

This brings in the issue of religion and trust. Putnam (1993) characterizes the Roman Catholic Church in Italy as vertical bonds of authority rather than horizontal bonds of fellowship. In Lithuania, the Roman Catholic Church has favored an authoritarian form of nationalism (Lieven, 1993). Using the notion of a humane economy, Marmefelt (2007) develops indices of morality and religion, and finds morality to be weaker and religion stronger in Lithuania than in Sweden, thus indicating a much less individualized moral responsibility in Catholic Lithuania than in Lutheran Sweden. However, a simple characterization of Lithuania as Catholic and Sweden as Lutheran to explain the differences in trust would be too easy. The Lutheran Protestant Nordic countries are sometimes referred to as post-Christian (Inglehart et al., 2004). Furthermore, acknowledging the Pagan heritage of Lithuania yields some interesting similarities between Paganism in Lithuania and Sweden. Rowell (1994) points out the decentralized nature of the cult, syncretism between Paganism and Christianity, and the high value of nature as common to Lithuanians and Scandinavians. Hence, the religious heritage, as an aspect of the unified field of consciousness, has elements of spontaneous sociability in both countries. Nevertheless, the individualized morality responsibility was weaker for Lithuania than for Sweden at the turn of the millennium. What about the political heritage?

State building of Pagan Grand Duke Gediminas during the fourteenth century in Lithuania and of King Gustav Vasa during the sixteenth century in Sweden gives a picture of two decentralized states, where spontaneous sociability was possible. During the reign of Gediminas, the poly-ethnic, multi-confessional character of the Grand Duchy was firmly established (Rowell, 1994). According to Rowell, Lithuanian government was a collaborative exercise of power by several blood-related princes and the Grand Duchy was divisible in three parts: Aukštaitija, the patrimony of the Grand Duke, Žemaitija, held by nobles controlled by a network of border settlements and dynastic marriages, and the Rus'ian territories.

In Sweden during the sixteenth century, the dissolution of the Union of Kalmar between the Kingdoms of Denmark, Norway, and Sweden led to the evolution of two new states, Denmark-Norway and Sweden, as relatively centralized Lutheran, princely states, where Gustav Vasa's Sweden, as political entity, was the King, the Council, and the inhabitants, inducing the King to use persuasion of ordinary people and to consult the Councilors of Västergötland and Finland separately (Gustafsson, 2000). Hence, Swedish government was based on cooperation with councilors and persuasion of ordinary people. The identification with the relatively centralized Lutheran, princely state was stronger among the elite than among ordinary people, but among ordinary people the identification was stronger in Sweden than in Denmark with Norway in between (Gustafsson, 2000). This suggests a positive correlation between the identification with the state and the political position of ordinary people, thus opening for civic enterprises connecting political and market enterprises.

Consequently, government was based on collaboration during the state building phases in both Lithuania and Sweden, but the collaboration took place between elites in Lithuania, while ordinary people were included as well as the elites in Sweden. This provided for a smooth structure of the Swedish field of consciousness, favorable to reciprocal sympathy,

while later events gave a very rugged structure of the Lithuanian field of consciousness, unfavorable to reciprocal sympathy.

The nominal union of Lithuania and Poland of 1386 and the subsequent Polish-Lithuanian Commonwealth, created through the Treaty of Lublin in 1569, had some lasting consequences on the links between the elite and ordinary people. The Lithuanian upper classes identified with their Polish counterparts, turning Russo-Polish following the partitions of Poland during the eighteenth century, when most of Lithuania became Russian (Rauch, 1974). The identification of the elite influenced social development. Serfdom was abolished in Estonia in 1816, Courland in 1817, and Livonia in 1819, but in Lithuania as late as 1861 with Russia, except for Suvalkija, where Code Napoleon yielded freedom in 1807 (Rauch, 1974). This should be seen in the light of the weakened links of the Lithuanian elite with Western Europe. During the eighteenth century, the Polish-speaking Lithuanian nobility had weak links with Western Europe, thus making Lithuania a backward agricultural country (Nørgaard and Johannsen, 1999). Lithuanian links with Western Europe declined from the fourteenth to the eighteenth century. In the Pagan empire, commerce grew, because Lithuania used her position near a crossroads of Baltic Sea-Black Sea and West European-Rus'ian-Central Asian trade routes, using Catholicism as a means to attract Western European merchants and craftsmen (Rowell, 1994).

As Bauer (2000) argues, trading activity is essential for the evolution of exchange economies, while Western commercial contacts are crucial for advancement. The Polish-Lithuanian Union, especially the Commonwealth, caused a decline in Lithuania's commercial links with the West and is a negative event having shaped the Lithuanian field of consciousness. The Poles are held responsible for the collapse of Lithuanian glory of the Grand Duchy (Vareikis, 1998). Smetona's mythology of the medieval Grand Duchy, which Rauch (1974) and Lieven (1993) put into the context of Smetona's authoritarian governance, is a representation of the Grand Duchy that deviates from Rowell's (1994) characterization of the Gediminid Grand Duchy as poly-ethnic, multi-confessional, and foreign trade-oriented, safeguarding international commercial routes, where a Pagan regime used the Catholic and Orthodox Churches as policy tools. Nevertheless, perceived history is what matters to intentional states. The weakness of liberal values in Lithuania (see Table 1) illustrates that Smetona created a rather resilient image of the medieval Grand Duchy.

Summing up, cognitive social capital can be characterized as elementary in Lithuania and substantial in Sweden, because the shared unified field of consciousness, or mental map, was shaped by historical events being destructive to reciprocal sympathy in Lithuania and constructive to reciprocal sympathy in Sweden.

5. SOCIAL CAPITAL AND CLIMATE EFFICIENT HUMAN DEVELOPMENT IN LITHUANIA AND SWEDEN

The preceding section established that Lithuania has elementary social capital in the form of a culture of weak reciprocal sympathy, while Sweden has substantial social capital in the form of a culture of strong reciprocal sympathy. This section will interpret this cultural difference as a difference in cognitive social capital. In order for culture to constitute social capital, it must have a positive value as factor of production. According to the Innovative

Exchange model, a culture of strong reciprocal sympathy would contribute to innovative exchange and thereby to the value of the ultimate resource – human imagination acting together with educated skills in a free society. This value is reflected in innovativeness that leads to human development by overcoming resource scarcities. Innovation has a positive value only to the extent that it contributes to human welfare, so it should be assessed in terms of human development. The *Human Development Report 2007/2008* (UNDP, 2007) considers climate change a massive threat to human development, in some places already undermining the international community's efforts to reduce extreme poverty. It regards the Earth's capacity to absorb carbon dioxide (CO₂) and other greenhouse gases being overwhelmed to be the heart of the climate change problem. Hence, innovation yielding human development must contribute to a smaller carbon footprint. Although considering global warming as an environmental resource scare and temporary concern, Simon (1996) nevertheless argues that a greenhouse effect due to income and population growth would be overcome by shifts to nuclear and other new sources of energy, thus reducing total emissions even as total energy consumption goes up. Consequently, innovation makes possible a high level of human development through energy intensive growth, but with low carbon intensity.

The stronger the innovative exchange convention, there will be more innovative investments, measured as the ratio of research and development (R&D) expenditures to GDP, and thereby a higher innovativeness, which yields a higher the real GDP per capita, but also more education, which itself contributes to innovativeness, and a higher life expectancy. Innovation may allow for a low carbon intensity of growth even if growth is energy intensive. Simon (1996) uses the notion of optimal level of pollution, thus establishing a trade-off between tastes for a cleaner environment and the desire for other goods. Hence, there is a trade-off between human development, on the one hand, and the emission of CO₂ and other greenhouse gases, on the other hand. Nevertheless, innovation may reduce the carbon footprint required to achieve human development.

The Human Development Index consists of a GDP index measured by GDP per capita in purchasing power parity US dollars, an education index measured by the adult literacy rate and the gross enrolment ratio, and a life expectancy index measured by life expectancy at birth (UNDP, 2007). Table 5 shows that Lithuania in 2005 had achieved significantly lower human development level, invested less in innovation, and had more carbon intensive growth than Sweden, although the energy intensity of growth was the same, thus reflecting a weaker innovative exchange convention in Lithuania than in Sweden. This suggests that the culture of weak reciprocal sympathy of Lithuania, as compared with the culture of strong reciprocal sympathy of Sweden, yields a weaker innovative exchange convention, which gives less innovation and a lower level of human development even if growth is more carbon intensive. Hence, the culture of weak reciprocal sympathy of Lithuania has a low value as cognitive social capital, while the culture of strong reciprocal sympathy of Sweden has a high value as cognitive social capital.

Looking on the historical development from wood, coal, oil to nuclear fission, Simon (1996) argues that it is reasonable to assume that humanity will develop a cheaper, cleaner, and more environmentally benign substitute for nuclear fission energy. Hence, the structure of energy sources reflects past innovation in energy supply. In addition to overcoming contemporary energy problems, there is an element of intergenerational sympathy. Boulding (1973) uses the notion of serial reciprocity, where each generation receives from the previous generation and gives to the next generation rather than paying back to the previous

generation. This means reciprocal sympathy in time as well as space that reflect moral culture.

Table 5. Human development, innovative investments, energy use, and carbon intensity in Lithuania and Sweden

	HDI ¹ (rank) 2005	R&D expenditures ² 2000-2005	GDP per unit of energy use ³ 2004	Carbon intensity of growth ⁴ 2004
Lithuania	0.862 (43)	0.008	4.5	0.32
Sweden	0.956 (6)	0.037	4.5	0.21

Source: UNDP (2007).

Notes:

1. Human Development Index: Its goalposts are: 100 and 40,000 purchasing power parity US dollars for GDP per capita, 0 and 100 per cent for adult literacy rate and gross enrolment ratio, and 25 and 85 years for life expectancy at birth.
2. Ratio of research and development expenditures to GDP.
3. 2000 purchasing power parity US dollar per kilogram of oil equivalent.
4. CO₂ emission per unit of GDP: kilotons of CO₂ per million of 2000 purchasing power parity US dollar.

Table 6. Share of total primary energy supply in Lithuania and Sweden in 2005

	Fossil fuels	Renewable energy	Nuclear energy
Lithuania	0.602	0.107	0.319
Sweden	0.351	0.299	0.362

Source: UNDP (2007).

Note: Fossil fuels include coal, oil, and natural gas, while renewable energy consists of hybrid, solar, wind, and geothermal energy and energy from biomass and waste.

Acting on climate change has an ethical dimension. UNDP (2007) argues that the present generations must accept the responsibility stewardship of the Earth and give equal ethical weight to future generation as they give to themselves. A culture of strong reciprocal sympathy would, with serial reciprocity, involve this stewardship of the Earth, thus inducing action on climate change. Strong reciprocal sympathy means that the present generations, building on previous generations, would be more capable of addressing climate change and avoiding fossil fuels. Table 6 shows that Lithuania has a higher share of fossil fuels and a much lower share of renewable energy in her total primary energy supply, which suggests a weaker serial reciprocal sympathy in Lithuania than in Sweden, thus reflecting elementary cognitive social capital in Lithuania and substantial cognitive social capital in Sweden.

Summing up, innovative investments, human development, and the carbon intensity of growth as well as the shares of fossil fuels and renewable energy as energy sources suggest a weaker innovative exchange convention in Lithuania than in Sweden that reflect their cultures of weak and strong reciprocal sympathy, respectively, implying that culture constitutes elementary cognitive social capital in Lithuania, but substantial cognitive social capital in Sweden.

6. CONCLUSION

It is necessary to study the cultural foundations of a free exchange society in order to understand why solutions to resource shortages are eventually found in such a society. Lithuania and Sweden are neighboring states in the Baltic Sea Area, whose economic integration will facilitate learning across member states when the involved cultures yield strong reciprocal sympathy that sustains innovative exchange throughout that region.

Civic, market, and political entrepreneurs are innovative traders who interact within the context of a correlated evolutionary Innovative Exchange game. Cultures of strong reciprocal sympathy yield a high probability that innovative exchange evolves. First, cultures of strong reciprocal sympathy are characterized by an understanding among traders that the other needs to benefit from an exchange if it is going to take place. Second, this understanding gives a great propensity to become involved in repeated interaction, thus increasing learning-by-trading and thereby the probability that innovative traders interact with each other.

The approach to achieve human dignity in Lithuania, as compared with Sweden, was less based upon civil society participation in general and spontaneous order participation in particular due to the moral culture, thus suggesting that civic entrepreneurs connected market and political entrepreneurs to a lesser extent in Lithuania than in Sweden. Cognitive social capital, which reflects the value of a culture's reciprocal sympathy, can be characterized as elementary in Lithuania, but substantial in Sweden, because the shared unified field of consciousness has been shaped by historical events being destructive to reciprocal sympathy in Lithuania and constructive to reciprocal sympathy in Sweden. As expected, innovative investments, human development, and the carbon intensity of growth as well as the shares of fossil fuels and renewable energy as energy sources suggest a weaker innovative exchange convention in Lithuania than in Sweden. Hence, culture constitutes elementary cognitive social capital in Lithuania, but substantial cognitive social capital in Sweden.

Since learning to overcome resource scarcities through economic integration within the Baltic Sea Area in the form of Baltic-Nordic learning networks would require that Baltic and Nordic cultures yield the same level of reciprocal sympathy, a comparative analysis of Lithuania and Sweden shows that cultural evolution in the Baltic countries must involve the emergence of strong reciprocal sympathy that makes a shared morality of social interactions in markets, civil societies, and states feasible, before learning within Baltic-Nordic learning networks to overcome resource scarcities can be viable.

APPENDIX

Let c be the correlation parameter and $\psi > 0$ when there is an implicit grant from buyer to seller and $\psi < 0$ when there is an implicit grant from seller to buyer. The implicit grant becomes: $\varepsilon = \psi(1-c)$. Since reciprocal sympathy increases the probability of repeated interaction, correlation becomes stronger in a culture with a stronger of reciprocal sympathy, so correlation becomes: $c = a\lambda$, $a > 0$. Consequently, the implicit grant is a function of reciprocal sympathy: $\varepsilon = \psi(1-a\lambda)$, $a > 0$. Correlation implies non-random pairing that gives the following probabilities of meeting strategy x when playing strategy y , $\text{prob}(x | y)$, where s

is the share of the other population playing x and $(1-s)$ is the share of the other population playing $(1-x)$:

$$\begin{aligned}\text{prob}(\text{INNO} \mid \text{INNO}) &= s+a\lambda(1-s) \\ \text{prob}(\text{FAIL} \mid \text{INNO}) &= (1-a\lambda)(1-s) \\ \text{prob}(\text{INNO} \mid \text{FAIL}) &= (1-a\lambda)s \\ \text{prob}(\text{FAIL} \mid \text{FAIL}) &= 1-(1-a\lambda)s\end{aligned}$$

Let g be the share of innovating sellers, those playing INNO, in the population of sellers and h the share of innovating buyers, those playing INNO, in the population of buyers.

Malthusian dynamics give the following growth of innovative sellers and buyers, respectively:

$$\dot{g} = g \left[A(h + a\lambda(1-h)) + \psi(1-a\lambda)^2(1-h) - \gamma^* - \psi(1-a\lambda) \right] (1-g) \quad (1)$$

where $A = \alpha^* + \lambda\beta^* + \psi(1-a\lambda)(1-\lambda) - \gamma^*$, and:

$$\dot{h} = h \left[B(g + a\lambda(1-g)) - \psi(1-a\lambda)^2(1-g) - \delta^* + \psi(1-a\lambda) \right] (1-h) \quad (2)$$

where $B = \beta^* + \lambda\alpha^* - \psi(1-a\lambda)(1-\lambda) - \delta^*$.

Since innovative action yields a higher payoff than non-innovative action in the long run when a solution to the resource shortage has been found, $A > \gamma^* + \psi(1-a\lambda)$ and $B > \delta^* - \psi(1-a\lambda)$. This assures that both playing INNO is adaptive ratifiable. However, assume that correlation is too small to make both playing INNO globally adaptive ratifiable, so $Aa\lambda < \gamma^* + \psi a\lambda(1-a\lambda)$ and $Ba\lambda < \delta^* - \psi a\lambda(1-a\lambda)$. Equation (1) shows that the share of innovative sellers is stable

when $g = 0$ or 1 , or $h = \tilde{h} = \frac{\gamma^* + \psi a\lambda(1-a\lambda) - Aa\lambda}{(1-a\lambda)(A - \psi(1-a\lambda))}$. Similarly, equation (2) shows that

the share of innovative buyers is stable when $h = 0$ or 1 , or

$$g = \tilde{g} = \frac{\delta^* - \psi a\lambda(1-a\lambda) - Ba\lambda}{(1-a\lambda)(B + \psi(1-a\lambda))}.$$

Local stability analysis of the Jacobian of the system of the two differential equations (1) and (2) gives the determinant, $\det J$, and the trace, $\text{tr} J$, below:

$$\begin{aligned}\det J &= \left[A(h + a\lambda(1-h)) + \psi(1-a\lambda)^2(1-h) - \gamma^* - \psi(1-a\lambda) \right] \\ &\quad \left[B(g + a\lambda(1-g)) - \psi(1-a\lambda)^2(1-g) - \delta^* + \psi(1-a\lambda) \right] (1-2g)(1-2h) \\ &\quad - (1-a\lambda)^2 (A - \psi(1-a\lambda))(B + \psi(1-a\lambda))gh(1-g)(1-h)\end{aligned} \quad (3)$$

$$\begin{aligned}
trJ = & \left[A(h + a\lambda(1-h)) + \psi(1-a\lambda)^2(1-h) - \gamma^* - \psi(1-a\lambda) \right] (1-2g) \\
& + \left[B(g + a\lambda(1-g)) - \psi(1-a\lambda)^2(1-g) - \delta^* + \psi(1-a\lambda) \right] (1-2h)
\end{aligned} \tag{4}$$

The Innovative Exchange game has two correlated evolutionary equilibria, which are its two conventions:

- i) *Innovative exchange convention*: All traders play INNO ($g = 1, h = 1$).
- ii) *State of nature convention*: All traders play FAIL ($g = 0, h = 0$).

A saddle point, $(g = \tilde{g}, h = \tilde{h})$, separates the basins of attraction of these two conventions.

Proof.

1. ($g = 1, h = 1$) with $A > \gamma^* + \psi(1-a\lambda)$ and $B > \delta^* - \psi(1-a\lambda)$ give:

$$det J = [A - \gamma^* - \psi(1-a\lambda)][B - \delta^* + \psi(1-a\lambda)] > 0$$

$$trJ = -[A + B - \gamma^* - \delta^*] < 0$$

Hence, ($g = 1, h = 1$) is adaptive ratifiable.

2. ($g = 0, h = 0$) with $Aa\lambda < \gamma^* + \psi a\lambda(1-a\lambda)$ and $Ba\lambda < \delta^* - \psi a\lambda(1-a\lambda)$ give:

$$det J = [Aa\lambda - \gamma^* - \psi a\lambda(1-a\lambda)][Ba\lambda - \delta^* + \psi a\lambda(1-a\lambda)] > 0$$

$$trJ = [(A+B)a\lambda - \gamma^* - \delta^*] < 0$$

Hence, ($g = 0, h = 0$) is adaptive ratifiable.

3. ($g = \tilde{g}, h = \tilde{h}$) with $A > \gamma^* + \psi(1-a\lambda)$, $B > \delta^* - \psi(1-a\lambda)$, $Aa\lambda < \gamma^* + \psi a\lambda(1-a\lambda)$, and $Ba\lambda < \delta^* - \psi a\lambda(1-a\lambda)$ give:

$$det J = -(1-a\lambda)^2 (A - \psi(1-a\lambda))(B + \psi(1-a\lambda)) \tilde{g}\tilde{h}(1-\tilde{g})(1-\tilde{h}) < 0$$

This implies that $(g = \tilde{g}, h = \tilde{h})$ is a saddle point.

When the payoffs of INNO, A and B , increase, the saddle point moves towards the state of nature convention ($g = 0, h = 0$), thus increasing the basin of attraction of the innovative exchange convention ($g = 1, h = 1$), because A and B are very large compared with $\psi(1-a\lambda)$.

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REFERENCES

- Bauer, P. (2000). *From Subsistence to Exchange and Other Essays*. Princeton, NJ: Princeton University Press.
- Beabout, G.R., Crespo, R.F., Grabill, S.J., Paffenroth, K., and Swan, K. (2002). *Beyond Self-Interest: A Personalist Approach to Human Action*. Lanham, MD: Lexington Books.
- Boulding, K.E. (1973). *The Economy of Love and Fear: A Preface to Grants Economics*. Belmont, CA: Wadsworth Publishing Company.
- Boulding, K.E. (1978). *Ecodynamics: A New Theory of Societal Evolution*. Beverly Hills, CA: Sage.
- Brennan, G., and Pettit, P. (2004). *The Economy of Esteem: An Essay on Civil and Political Society*. Oxford : Oxford University Press.
- Chamlee-Wright, E. (2000). *The Cultural Foundations of Economic Development: Urban Female Entrepreneurship in Ghana*. London, UK, and New York, NY: Routledge.
- Chang, H.-J., and Kozul-Wright, R. (1994). Organising Development: Comparing the National Systems of Entrepreneurship in Sweden and South Korea. *Journal of Development Studies*, 30: 859-891.
- Colombatto, E. (2001). On the Concept of Transition. *Journal of Markets and Morality*, 4, 269-288.
- Commons, J.R. (1899-1900 [1965]). *A Sociological View of Sovereignty*, A series of articles published in the *American Journal of Sociology*. New York, NY: Augustus M. Kelley.
- Felice, F. (2001). The Ethical Foundation of the Market Economy: A Reflection on Economic Personalism in the Thought of Luigi Sturzo. *Journal of Markets and Morality*, 4, 217-239.
- Friedman, D. (1991). Evolutionary Games in Economics. *Econometrica*, 59, 637-666.
- Friedman, D. (1998). On the Economic Applications of Evolutionary Game Theory. *Journal of Evolutionary Economics*, 8, 15-43.
- Giddens, A. (1990). *The Consequences of Modernity*. Stanford, CA: Stanford University Press.
- Gustafsson, H. (2000). *Gamla riken, nya stater: Statsbildning, politisk kultur och identiteter under Kalmarunionens upplösningsskede, 1512-1541* (Old Kingdoms, New States: State Formation, Political Culture, and Identities during the Dissolution of the Union of Kalmar, 1512-1541). Stockholm, Sweden: Atlantis.
- Gwartney, J., and Lawson, R. (with Sobel, R.S., and Leeson, P.T.) (2007). *Economic Freedom of the World: 2007 Annual Report*. Vancouver, BC, Canada: The Fraser Institute (<http://www.freetheworld.com/2007/EFW2007BOOK2.pdf>).
- Hargreaves Heap, S. (2005). The Mutual Validation of Ends. In B. Gui, and R. Sugden (Eds.), *Economics and Social Interaction: Accounting for Interpersonal Relations* (pp. 190-205). Cambridge, UK: Cambridge University Press.
- Hayek, F.A. von (1937). Economics and Knowledge. *Economica*, 4, 33-54. Reprinted in Hayek (1948) (pp. 33-56).
- Hayek, F.A. von (1945). The Use of Knowledge in Society. *American Economic Review*, 35, 519-530. Reprinted in Hayek (1948) (pp. 77-91).
- Hayek, F.A. von (1948). *Individualism and Economic Order*. Chicago, IL: University of Chicago Press.

- Hayek, F.A. von (1952). *The Sensory Order: An Inquiry into the Foundations of Theoretical Psychology*. Chicago, IL: University of Chicago Press.
- Hayek, F.A. von (1973 [1982]). *Law, Legislation, and Liberty, Vol. 1: Rules and Order*. In *Law, Legislation, and Liberty: A New Statement of the Liberal Principles of Justice and Political Economy*. London, UK: Routledge and Kegan Paul.
- Hayek, F.A. von (1976 [1982]). *Law, Legislation, and Liberty, Vol. 2: The Mirage of Social Justice*. In *Law, Legislation, and Liberty: A New Statement of the Liberal Principles of Justice and Political Economy*. London: Routledge and Kegan Paul.
- Hayek, F.A. von (1979 [1982]). *Law, Legislation, and Liberty, Vol. 3: The Political Order of a Free People*. In *Law, Legislation, and Liberty: A New Statement of the Liberal Principles of Justice and Political Economy*. London; UK: Routledge and Kegan Paul.
- Heyne, P. (1985). The Concept of Economic Justice in Religious Discussion. In W. Block, G. Brennan, and K. Elzinga (Eds.), *Morality of the Market: Religious and Economic Perspectives* (pp. 463-482). Vancouver, BC, Canada: The Fraser Institute.
- Hicks, J. (1973). *Capital and Time: A Neo-Austrian Theory*. Oxford, UK: Oxford University Press.
- Hume, D. (1777 [1985]). *Essays: Moral, Political, and Literary*. E. F. Miller (Ed.). Indianapolis, IN: Liberty Classics.
- Inglehart, R., Basáñez, M., Díez-Medrano, J., Halman, L., and Luijckx, R. (Eds.) (2004). *Human Beliefs and Values: A Cross-Cultural Sourcebook Based on the 1999-2002 Values Surveys*. México, Mexico: Siglo XXI Editores.
- Kolm, S.-C. (2005). The Logic of Good Social Relations. In B. Gui, and R. Sugden (Eds.), *Economics and Social Interaction: Accounting for Interpersonal Relations* (pp. 174-189). Cambridge, UK: Cambridge University Press.
- Krishna, A. (2000). Creating and Harnessing Social Capital. In P. Dasgupta, and I. Serageldin (Eds.), *Social Capital: A Multifaceted Perspective* (pp. 71-93). Washington, DC: The World Bank.
- Lachmann, L.M. (1956 [1978]). *Capital and Its Structure*. Kansas City, KS: Sheed Andrews and McMeel.
- Lavoie, D.C., and Chamlee-Wright, E. (2000). *Culture and Enterprise: The Development, Representation, and Morality of Business*. A Cato Institute Book. London, UK, and New York, NY: Routledge.
- Lieven, A. (1993). *The Baltic Revolution: Estonia, Latvia, Lithuania, and the Path to Independence*. New Haven, CT: Yale University Press.
- Marmefelt, T. (1998). *Bank-Industry Networks and Economic Evolution: An Institutional-Evolutionary Approach*. Aldershot, UK, and Brookfield, VT: Ashgate.
- Marmefelt, T. (2004). Institutional Endowments and the Lithuanian Holding as Innovative Network: A Problem of Institutional Compatibility in the Baltic Sea Area. *Review of Austrian Economics*, 17, 87-113.
- Marmefelt, T. (2007). Civil Society Formation and Global Exchange: Lithuania, Sweden, the Baltic Sea Area, and the World. *Indian Journal of Economics and Business*, Symposium on Economic Development, Transition Economics, and Globalization: Austrian and Public Choice Perspectives, Special Issue, 109-127.
- Mises, L. von (1949). *Human Action: A Treatise on Economics*. New Haven, CT: Yale University Press.

- Nørgaard, O., and Johannsen, L. (with Skak, M., and Hauge Sørensen, R.) (1999). *The Baltic States after Independence* (second edition), Cheltenham, UK, and Northampton, MA: Edward Elgar.
- OECD (2001). *Reviews of Foreign Direct Investment: Lithuania*. Paris, France: OECD.
- Pelligra, V. (2005). Under Trusting Eyes: The Responsive Nature of Trust. In B. Gui, and R. Sugden (Eds.), *Economics and Social Interaction: Accounting for Interpersonal Relations* (pp. 105-124). Cambridge, UK: Cambridge University Press.
- Putnam, R.D., (with Leonardi, R., and Nanetti, R.Y.) (1993). *Making Democracy Work: Civic Traditions in Modern Italy*. Princeton; NJ: Princeton University Press.
- Rauch, G. von (1974 [1995]). *The Baltic States: The Years of Independence: Estonia, Latvia, Lithuania, 1917-1940*. New York; NY: St. Martin's Press.
- Rizvi, S.A.T. (2002). Adam Smith's Sympathy: Towards a Normative Economics. In E. Fullbrook (Ed.), *Intersubjectivity in Economics: Agents and Structures* (pp. 241-253). London, UK, and New York; NY: Routledge.
- Rose, R. (2000). Getting Things Done in an Antimodern Society: Social Capital Networks in Russia. In P. Dasgupta, and I. Serageldin (Eds.), *Social Capital: A Multifaceted Perspective* (pp. 147-171). Washington, DC: The World Bank.
- Rowell, S.C. (1994). *Lithuania Ascending: A Pagan Empire within East-Central Europe, 1295-1345*. Cambridge, UK: Cambridge University Press.
- Sally, D. (2001). On Sympathy and Games. *Journal of Economic Behavior and Organization*, 44, 1-30.
- Santelli, A.J., Sikkenga, J., Sirico, R.A., Yates, S., and Zúñiga, G. (2002). *The Free Person in the Free Economy: A Personalist View of Market Economies*. Lanham, MD: Lexington Books.
- Schelling, T.C. (1960). *The Strategy of Conflict*. Cambridge, MA: Harvard University Press.
- Schultz, W.J. (2001). *The Moral Conditions of Economic Efficiency*. Cambridge: Cambridge University Press.
- Searle, J. (1999). *Mind, Language, and Society: Philosophy in the Real World*. London, UK: Weidenfeld and Nicholson.
- Serageldin, I. and Grootaert, C. (2000). Defining Social Capital: An Integrated View. In P. Dasgupta, and I. Serageldin (Eds.), *Social Capital: A Multifaceted Perspective* (pp. 40-58). Washington, DC: The World Bank.
- Shionoya, Y. (2005). *Economy and Morality: The Philosophy of the Welfare State*. Cheltenham, UK, and Northampton, MA: Edward Elgar.
- Simon, J.L. (1996). *The Ultimate Resource 2*. Princeton, NJ: Princeton University Press.
- Skyrms, B. (1996). *Evolution of the Social Contract*. Cambridge, UK: Cambridge University Press.
- Smith, A. (1759 [1976]). *The Theory of Moral Sentiments*. Oxford, UK: Clarendon Press.
- Stråth, B. (1996). *The Organisation of Labour Markets: Modernity, Culture, and Governance in Germany, Sweden, Britain, and Japan*. London, UK, and New York, NY: Routledge.
- Sugden, R. (2005). Fellow-Feeling. In B. Gui, and R. Sugden (Eds.), *Economics and Social Interaction: Accounting for Interpersonal Relations* (pp. 52-75). Cambridge, UK: Cambridge University Press.
- Torstendahl, R. (1991). *Bureaucratisation in Northwestern Europe 1880-1985: Domination and Governance*. London, UK, and New York, NY: Routledge.

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- UNDP (2007) *Human Development Report 2007/2008: Fighting Climate Change: Human Solidarity in a Divided World*. Basingstoke, UK, and New York, NY: Palgrave Macmillan (http://hdr.undp.org/en/media/hdr_20072008_en_complete.pdf)
- Uphoff, N. (2000). Understanding Social Capital: Learning from the Analysis and Experience of Participation. In P. Dasgupta, and I. Serageldin (Eds.), *Social Capital: A Multifaceted Perspective* (pp. 215-249). Washington, DC: The World Bank.
- Vareikis, V. (1998). The Role of History in Lithuanian Society: From the Nineteenth-Century National Revival to the Fall of Communism: *Es ubi gloria nunc Lituania?* In K. Junefelt and M. Peterson (Eds.), *Cultural Encounters in East Central Europe* (pp. 28-39). FRN-R-98/11-SE, Stockholm, Sweden.
- Wagner, R.E. (2007). *Fiscal Sociology and the Theory of Public Finance*. Cheltenham, UK, and Northampton, MA: Edward Elgar.
- Wojtyla, K. (1979). *The Acting Person*. Dordrecht, Netherlands: D. Reidel.
- Yeager, L.B. (2001). *Ethics as Social Science: The Moral Philosophy of Social Cooperation*. Cheltenham, UK, and Northampton, MA: Edward Elgar.

Chapter 3

SOCIAL BEHAVIOUR NETWORKS

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ABSTRACT

Social interaction through the Internet is becoming commonplace today. Internet users may wish to work together across organisational boundaries and do so with limited understanding of one another. Therefore, social relations appear to be more dynamic and volatile than the social interaction in an intranet. In order to achieve high efficient social interaction in the Internet, it is necessary to develop new techniques to support the Internet users. In this chapterpaper, the social behaviour network(SoBeNet) is proposed to manage actions and reactions of agents in the Internet environment for social interaction,. In the SoBeNet, an agent on behalf of an Internet user senses web document changes and acts or reacts accordingly for achieving its own missions or goals. Distributed agents then interact with each other in a common knowledge space to self-organise a virtual organisation. Each agent in the SoBeNet is composed of an ontology based virtual state space, a fuzzy logic based virtual sensor, a behaviour network driven virtual controller, and a belief model based virtual adaptive machine for interaction in dynamic and uncertain web-environments. A prototype of the SoBeNet built on JADE is developed by following the theory proposed in this chapterpaper and a case study is carried out to illuminate the design methodology and validate the effectiveness of the SoBeNet in dealing with dynamics and uncertainties.

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INTRODUCTION

Social interaction is a dynamic, changing sequence of social actions between individuals (or groups) who try to affect or take account of each other's subjective experiences or intentions. Today, the Internet has changed the ways of traditional social interaction. According to the Office of National Statistics, there are now around 15m households in Britain with internet access and this figure is rising all the time. As a result, the Internet is becoming an important social tie for social interaction, such as for chatting, shopping, information exchanging, or even creating a new organisation for some purposes, which is referred as a virtual organisation(VO). Due to the prevalence of the Internet, individuals may want to work together across organisational boundaries but do not have much prior knowledge on which to base relations with each other. VO's are developing to be highly dynamic and less predictable. Therefore a key aspect to study for social interaction in the Internet is how to organise independently-developed individuals with limited understanding of one another in terms of exchanging local information and integrating local processes, which reflects the *ad hoc opportunistic nature* and the *redundancy* nature of a VO[1][2].

A VO comprises of a set of independent individuals or organisations that share resources and skills in order to achieve a set of missions/goals through interaction on computer networks. Research into the support necessary to implement social interaction in a VO has been widely carried out in different areas such as: virtual enterprises [3], e-business [4] and grid computing [5]; and common requirements can be identified [6][7][8]. These include: the ability to assign job priorities through collaborative shared goals, coordinated and controlled access to shared resources, delegation, discovery services and collaborative processes. There are two general approaches taken to implement a VO: transaction-oriented layer-based and as a distributed multi-agent system[3]. The transaction-oriented layer-based approach usually applies a top-down design approach to address goals and subgoals. A protocol for interaction is defined beforehand by a consortium or standards body as a reference model, including meta-data and process models, and subsequently deployed by customising a cooperation layer of an existing IT infrastructure. This produces a structurally static VO. Examples of this approach can be seen in the ARPA NIIIP (National Industrial Information Infrastructure Protocols) and the EU DIECoM(Distributed Integrated Environment for Configuration Management) projects. However it has been found that this approach is deficient in open and dynamic environments due to its inflexibility and operational inefficiency [3]. Today's VOs are faced with a more dynamic environment, such as those emergent Web 2.0 applications: RSS feeds, WIKI, Blogs, Social Book Mark, FaceBook, Podcast etc., which requires flexible and fast responses to changing information and goals during interaction. In comparison to the transaction-oriented layer-based approach, multi-agent based approaches[1][8][9][10] could be more suitable to support the new VOs, from partnership seeking, partnership configuration, partnership execution to partnership dissolution. An agent can be viewed as perceiving its environment through sensors and acting upon that environment through actuators[11]. Whilst RSS feeds in the Internet are providing almost instant awareness of information updates, software agents could help internet users conduct real-time and automatic interaction with others. Although general frameworks to support distributed agent based VOs have been developed, e.g. mobile agent based architectures[1], the required intelligent mechanisms and techniques have not been well studied to support the social

interaction in the new VOs. The next generation of VO applications will have to cater for partially observable, ambiguous and dynamic peers and resources and must address:

- i) *Rich semantics*: Agent-based VOs require a semantics-oriented approach in which human knowledge is generally represented in a hierarchy. Past agent-based research in VOs often flattened the hierarchy of knowledge into a free text vector with simple-valued attributes e.g. with keywords, price, delivery time, whilst omitting semantic relations [12][13].
- ii) *Rich sensors*: Symbolic AI has been widely used to support restrictive information sensing, matchmaking or consistency checking by proving subsumption and (un)satisfiability under a closed-world assumption [14]. Agents in a VO require a greater capability to deal with uncertainties because there is no prior agreement on how knowledge is represented. Additionally agents may have very different objectives [13]. Agents need to ascertain their degree of similarity to achieve flexible sensing and matching [15], especially during the early stages of social interaction.
- iii) *Rich responses*: VOs are highly dynamic. An individual may join in or leave a VO at any time. Most research ignores such temporal dynamics during cooperation. It is crucial to develop a behaviour network to respond to changes and provide learning and adaptive capability to the environment based on historical experience.

There has been increased research interest in recent years addressing i.) and ii.), especially in peer-to-peer environments e.g. Bluetooth service discovery [16], grid computing [17] and the electronic marketplace [18]. Although description logic can be used for similarity ranking by counting missing/not-implied concept names and loose characteristics between advertisements [18], the distinguishable granularity is usually coarse grain and the ability to handle fuzziness and uncertainty is limited. Fuzzy logic has been extended to description logic for representing fuzzy knowledge using continuous membership, such as f-Shin [19] and rule-based f-SWRL [20].

In established VO approaches, as in DIECoM[30], temporal dynamics are usually modelled as workflows using Petri Nets or State Machines [21]. This requires the centralised modelling and deliberative planning of a rigid process for a goal. However, in a highly dynamic environment, it may not be possible to model the environment or to plan a correct response for reaching the goal. Business processes are very difficult to maintain in distributed workflows and especially for inter-organisational workflows [22][23]; it has been shown that agent-based solutions are necessary for flexible and continuously changing processes in VOs. In the AI research community it has been demonstrated that a behaviour-based paradigm [24][25] is a more feasible approach than a deliberative paradigm for interaction within a highly uncertain and dynamic environment. In a behaviour-based paradigm activities are not hard wired and are not precompiled but rather are activated as the result of emergent functionality. Unlike traditional workflow models this approach provides an intrinsic mechanism to support self-organisation and to cope with resource limits and incomplete knowledge. However most behaviour-based approaches, built on a subsumption architecture [24], lack the capability to model goal-driven mechanisms across complex behaviour networks. Such complex goal-driven capability is fundamental and essential for the social interaction in the Internet. Goal-driven behaviour nets were first proposed by Maes [26] to address the problem of the “brittleness, inflexibility, and slow response” of classical

workflow approaches. They provide an approach to develop goal-oriented systems by implementing an energy spreading mechanism from goals and current state. Agent-based behaviour net systems were later implemented e.g VMattie and CMattie [27][28], and perform quite well in some highly dynamic scenarios such as robot football [29].

In this paper, we propose a novel synthesis of approaches to deal with a dynamic and partially observable VO for social interaction in the Internet. It is a distributed behaviour network based approach organised in a more dynamic, loosely coupled and self-organisational way than that previously attempted in VOs and is named as Social Behaviour Network(SoBeNet). The SoBeNet is a distributed multi-agent system in the Internet. An agent in the SoBeNet senses the RSS updates of other agents via virtual sensors and feeds to a virtual controller. The virtual controller manages a behaviour net fragment, in which the executable functionality of an agent is only apparent when it has enough activation energy from its goal or the sensed states. After the agent takes an action, it will update its RSS documents and cause activation energy spread to other physically partitioned behaviour nets. Hence distributed agents interact with each other in a spontaneous way and form a VO with diverse local goals/missions.

On the basis of the Java agent development environment(JADE), a SoBeNet software platform is developed to support social interaction in the Internet, which is composed of an OWL documents defined virtual state space, an RSS feeds perceived virtual sensor and a behaviour driven virtual controller. A practical scenario is implemented by using the SoBeNet platform to illustrate its organisational capability in a dynamic and uncertain environment, i.e. the Internet.

SOBENET ARCHITECTURE

Social interaction in the Internet goes through a lifecycle from interaction preparation stage, interaction stage, to interaction dissolution stage. The interaction preparation is accomplished by finding interested information from the Internet and establishing interaction links with some users. During the interaction, the users need to communicate each other and generate events for activation of appropriate behaviours. Due to lack of technique support today, the interaction lifecycle is often managed manually so that both efficiency and the scope of social interaction are very limited. For example, a new product development in a company requires a large amount of manpower force to search for suitable techniques, OEM components, and cooperation partners because more than 60% content in a complex product needs to be delegated to system suppliers or OEMs today. Currently such intellectual activities for searching, matching, and negotiating are mainly conducted by experienced engineers, e.g. searching the web, discussing in the MSN and telephoning suppliers, but with very little available tool support. Consequently, new product prototyping costs very high in comparison to design and manufacturing stages, where sophisticated CAD and CAM tools can provide efficient support. It is necessary to develop techniques and software tools to support social interaction in the Internet. The SoBeNet is a distributed platform and tool kit for this purpose. An engineer with his/her schematic design in mind can work out an initial product tree as a blueprint. An agent, taking this tree and the associated requirements as its goal, will receive the RSS feeds from component suppliers and potential partners and

automatically match information to fill in and expand the tree. It aids the engineer conduct product configuration and design tasks. Through RSS based information update and exchange, a group of distributed agents can be self-organised for development of the new product.

A SoBeNet is composed of distributed agents to support the whole lifecycle of social interaction in the Internet but without a predefined lifecycle model.

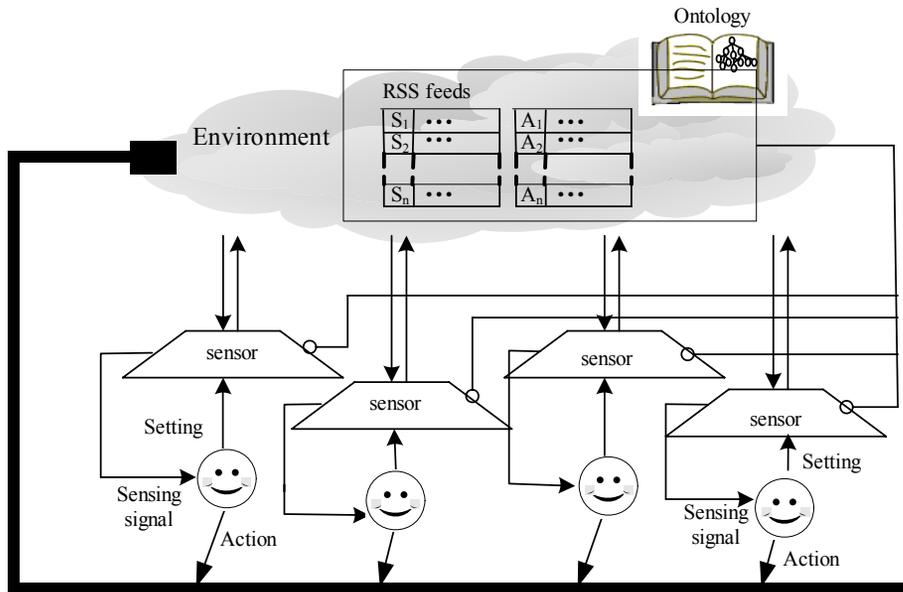


Figure 1. Architecture of the SoBeNet.

Each agent is a software robot on behalf of an Internet user who is willing to interact with others for some missions/goals. It can set up links with the interested websites or users through RSS feeds and monitor the changes of the web content. Every agent manages a set of self-defined behaviour modules, which are selected to be activated for achieving its local goal by an energy spread mechanism. The interaction among agents is thus taken place spontaneously. Therefore, multiple agents work toward diverse local goals but are self-organised into a harmonic social behaviour network. In order to achieve these, the SoBeNet has to provide agents with rich semantics, rich sensors and rich responses. The schematic diagram of the SoBeNet is shown in Figure 1:

The running environment of the SoBeNet is the Internet, which is large scale, distributed and heterogeneous. In order to facilitate interaction in this environment, some assumption could be made:

- a) The SoBeNet works in a known community, which constraint users having common interests.
- b) The community has common knowledge, which is defined by an ontology for information exchange.

An ontology allows the rich semantics of web documents to be provided in a machine-readable way. This will form a TBox data source defined in OWL for composing RSS documents in the SoBeNet. A set of specific ABox OWL documents described by the TBox specify the current state and goals of the SoBeNet in a community, which constitute a virtual state space of the SoBeNet. Only the relevant aspects to a set of tasks in a community are defined in the TBox to avoid an extremely complicated and huge space. The definition of an ontology enables agents to understand meaning of RSS feeds from other agents, this is implemented by virtual sensors.

A structure diagram of an agent is shown in Figure2. Each agent in the SoBeNet has several virtual sensors. A virtual sensor can perceive and reason about changes in RSS feeds. It serves two purposes. Firstly it allows behaviour net fragments to detect relevant changes in the state space and goals, i.e. detects events for behaviour activation. Secondly, for interpretation of RSS documents, it facilitates fuzzy matchmaking between expected criteria for interaction and received RSS feeds from candidates, i.e. it provides a rich sensor. A virtual sensor conducts logic based binary assessment about the executability of a behaviour and is also able to provide a match-degree as a measure of semantic closeness between two RSS statements.

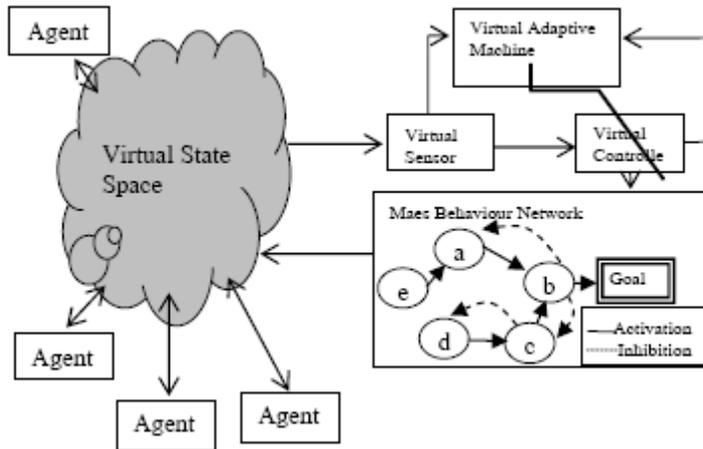


Figure 2. SoBeNet agent structure diagram.

Each agent (Figure 2) contains, as its “process model”, a local Maes behaviour network which is governed by a virtual controller. The virtual controller selects reasonable actions according to activation/inhibition energies induced from the virtual sensors and local goal. The social interaction in the VO is thus driven by goals and the state of artefacts in the virtual state space but without an explicit cooperation model.

In addition, each agent maintains a virtual adaptive machine to provide the virtual controller with learning and predictive capability. It maintains a belief model about the VO based on historical experience and predicts other agents’ future behaviour patterns. This allows an agent to be able to reason on the suitability of other agents to take part in collaboration for achieving its goal. The virtual adaptive machine has been reported in [31] and will not be discussed in this paperchapter.

The following pseudo codes demonstrate implementation of an agent in the SoBeNet, from perception, behaviour selection, to action.

```

procedure RUN-ENVIRONMENT(state, UPDATE-FN, agents, termination)
inputs:
state, the initial state of the environment
UPDATE-FN, function to modify the environment
agents, a set of agents
modules, a set of behaviour modules in the agent
termination, a predicate to test when having done
repeat
for each agent in agents do
PERCEPT[agent] <-GET-PERCEPT(agent, state)
end
for each agent in agents do
SELECT[module]<-GET-ENERGY(agent,module)
ACTION[agent]<-PROGRAM[agent](PERCEPT[agent])
end
state <- UPDATE-FN(actions, agents, state)
until termination(state)

```

VIRTUAL STATE SPACE AND VIRTUAL SENSORS

Nowadays RSS feeds have been adopted by almost all mainstream websites because of its convenience and speediness to propagate frequently updated web content to huge amount of users. In order to process RSS feeds automatically, it is often to take advantage of the sophisticated text mining methods. Fuzzy inference based and sequence kernel based approaches were presented to measure textual similarity between RSS-formatted documents[32]. In paper [33], three statistical feature selection methods were evaluated for ranking significance of terms in an RSS feed corpus and the authors pointed out that topic detection [34] or automatic text classification methods [35] were applicable to RSS documents. Although RSS feeds are indeed a sort of textual documents, they are better structured and have a close relationship with the semantic web; especially RSS1.0 builds on the RDF (Resource Description Framework). Underpinning semantics could facilitate machine processing of RSS feeds.

Information providers publish their information in the RSS format and web users may subscribe their favourite RSS feeds. A web user may be interested merely in some topics. Therefore, a virtual sensor is developed for each agent in the SoBeNet, which connects with incoming RSS stream and selects messages that are close enough in semantics to the interest.

An illustrative RSS feed from a job publishing site is shown below:

```

<rss version ="2.0">
<channel>
  <title> Yahoo! HotJobs:DVR</title>

```

```

<link>http://hotjobs.yahoo.com/jobs/USA/All/All-jobs</link>
<description>Top HotJobs results for jobs matching: DVR</description>
<webMaster>webmaster-rss@hotjobs.com</webMaster>
<language>en-us</language>
...
<item>
<title>Java Developers - Beta Soft Systems - Fremont, CA USA</title>
<link>http://pa.yahoo.com/*http://us.rd.yahoo.com/hotjobs/rss/evt=23685/*http://hot
jobs.yahoo.com/jobseeker/jobsearch/job_detail.html?job_id=J987065YO </link>
<description> ... to work with our top clients in USA belonging to any industry ... .-
BS/MS/MBA degree/Eng. (CS, MIS,CIS,IS,IT,CS... </description>
</item>
.....
<item>
<title> Software Engineer – Video MPEG Compression - Sigma Designs, Inc. -
Milpitas, CA USA</title>
<link>http://pa.yahoo.com/*http://us.rd.yahoo.com/hotjobs/rss/evt=23685/*http://hot
jobs.yahoo.com/jobseeker/jobsearch/job_detail.html?job_id=J497490PV </link>
<description> ... </description>
</item>
</channel>
</rss>

```

From above illustration, an RSS feed is composed of a channel and a series of items. An `<item>` defines a summary of an article or a story and provides formatted content entries for RSS feeds publication. In order to simplify presentation, only the titles of items are taken into account in this chapterpaper, which summarise the published items using several informative words.

In the SoBeNet, each virtual sensor perceives states of other agents from RSS feeds. Since the Internet users are extremely diverse, literal description of the RSS feeds have inherent ambiguity and uncertainty due to various synonyms and jargons. The ambiguity and uncertainty in RSS documents can be alleviated by introducing ontology, which provides a common comparison basis for frequently used terms or concepts in RSS feeds. The ontology of a domain forms a TBox data source defined in OWL for composing RSS documents in the SoBeNet. A set of specific ABox OWL documents, which are TBox-compliant, constitute a virtual state space of the SoBeNet.

Suppose that the ontology is defined as:

$$\Omega_C \equiv R_i(e_1, e_2, \dots, e_N) \quad (1)$$

where $e_1 \dots e_N$ are entities (concepts, terminologies, properties, attributes) used in the domain and R_i is the set of relationships between the entities and can be represented as a graph. An example of an ontology fragment in the domain of Electrical Device Development is shown in Figure 3. It has 14 entities:

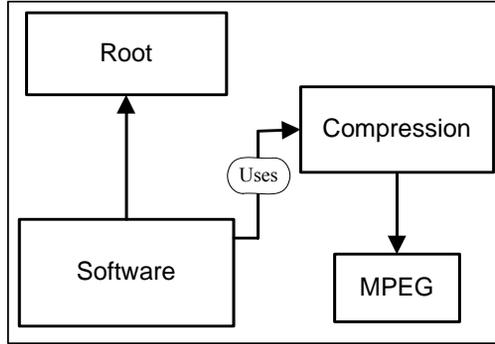


Figure 4. A publisher's ontology instance.

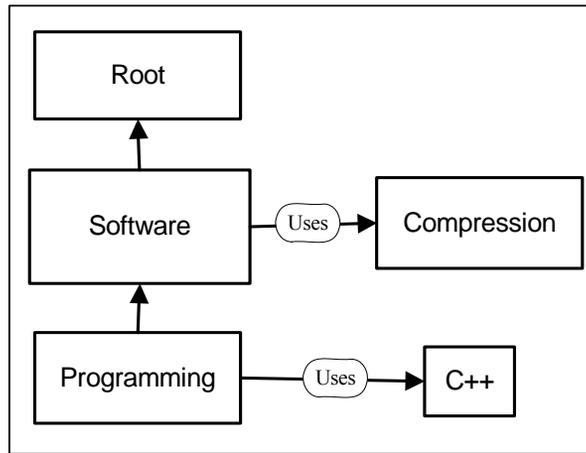


Figure 5. A subscriber's ontology instance.

Now the information from an RSS publisher and interest of a user are represented formally in accordance with the ontology definition. The interest driven attention of a virtual sensor is a process of semantic matchmaking, which compares similarity between ontology instances. For this purpose, a feature vector needs to be further defined as a numerical representation of an ontology instance:

$$V(t)=[s_1, s_2, \dots, s_N]^T \quad (2)$$

The component s_i of $V(t)$ has a one-to-one correspondence to the entity e_i in the ontology definition (1). The $s_i \in [0,1]$ is the semantic closeness, inverse of a semantic distance, between e_i and the root in the ontology instance:

$$s_i = \begin{cases} e^{-\alpha DIS(e_i, root)} & \text{if } e_i \text{ appeared} \\ 0 & \text{if } e_i \text{ not appeared} \end{cases} \quad (3)$$

where the $Dis(e_i, root)$ is the semantic distance between the entity e_i and the root in an instance e.g. Figure3 for a publisher and Figure4 for the interest of a subscriber. The α is a steepness measure [36].

In order to deal with the automation of knowledge extraction, semantic distances or similarities between concepts have been researched, for example semantic web matchmaking [37] and conceptual clustering of database schema[38]. Semantic distance can be used to characterise dissimilarities between two concepts, terminologies or objects. Usually a distance between two objects in an ontology graph is the shortest path between them. The path description greatly depends on the viewpoint of observations. Different types of semantic distances were proposed in [38]: visual distance, hierarchical distance and cohesive distance etc. For example a visual distance is defined from the observation that two objects semantically linked by a relationship are very often graphically close. In fact different semantic distances can be defined from domain perspective. In terms of the *visual distance*, the pseudo code for the transferring an ontology instance into a feature vector can be illustrated below:

```

BEGIN
For each entity i Do  $s_i=0$  Endfor
For each entity i on the graph
Do  $Dis(e_i, root)$ = the shortest distance from the root to entity i
 $s_i$  is calculated by equation (3)
Endfor
V(t) is obtained
END

```

The semantic representation of a RSS feed in the virtual state space goes through two steps. Firstly the corresponding ontology instance is extracted from the received RSS feed using the ontology definition. Then, based on the semantic distance, the virtual sensor converts it to a numerical feature vector, which indicates how many entities are related to the RSS item and to which extent.

Once the feature vector has been obtained the interest-driven attention becomes a matchmaking process between two feature vectors from an RSS publisher and a subscriber. Usually, a feature vector in a virtual state space is highly-dimensional and the entities (e_1, e_2, \dots, e_N) are highly correlated by the ontology. This is the main difference from typical data clustering techniques, in which each dimension is supposed to be orthogonal to others and a correlation analysis can tell us the similarity between two full space vectors. Due to high redundancy and correlation of the entities, it may be possible that there are a few dimensions on which the points are distant from one another in the virtual state space even though they are semantically very close. For example someone who advertised that she/he can do a job of “software development” but did not explicitly say that she/he can program using “C++” might fail to be identified for a job in “C++ programming”. In fact “Software” and “C++” have a close semantic relation as indicated by the ontology in Figure 3.

A virtual sensor needs to be able to deal with ambiguity for detection of interested content. According to the principle of IPDI(increasing precision with decreasing intelligence)[39], different roles in an intelligent system may need different precision for

information processing. For instance, in an organisation, a strategy-maker requires more intelligence but less precision than an employee. As a result, dimension reduction of a feature vector can be conducted so that several semantically close entities can be merged to a high-level concept according to certain resolution. The resolution is set by a user to reflect intelligence level of a task. A virtual sensor with variable-resolution to deal with semantic redundancy in a feature vector is implemented by hierarchical clustering of ontology:

Step 1: Extract the semantic distance matrix from ontology.

$$D = \begin{bmatrix} 0 & d(1,2) & \cdots & d(1,N) \\ d(2,1) & 0 & \cdots & d(2,N) \\ & & \cdots & \\ d(N,1) & d(N,2) & \cdots & 0 \end{bmatrix} \quad (4)$$

where $d(i,j)$, $i,j=1\dots N$, is a semantic distance between concept e_i and concept e_j , for example, using visual distance [38].

Step 2: Hierarchical clustering analysis (HCA) [40] is employed to cluster similar concepts according to concept distances in D . It is a bottom-up merging process. Initially all entities are considered as independent clusters at the bottom level. At each further step, the closest two clusters are merged to form a new cluster at a higher-level. Repeating the process until a single concept will result in a binary tree, as shown in Figure6 for ontology defined in Fig3. Whilst decreasing resolution (increasing semantic distance) a merged concept reflects a view of “increasing intelligence”.

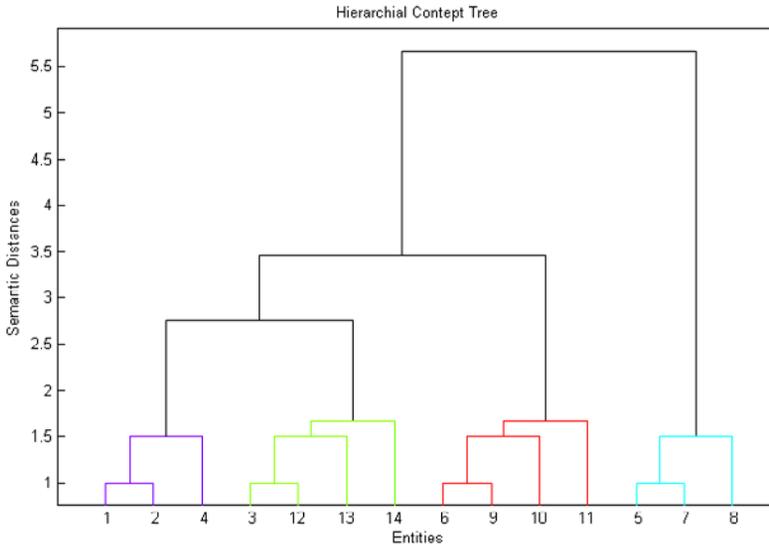


Figure 6. Hierarchical concept tree.

Step 3: For interest-driven attention, a resolution is set by a user according to the required precision/intelligence of a task. The feature vectors of a received RSS feed and the interest are

both compressed to a short feature vector with a reduced dimension according to the resolution.

Step 4: Calculate the degree of similarity between the two short feature vectors as the virtual sensor output.

An Example

The proposed virtual sensor with variable resolution for measure of interested RSS feeds can be depicted in Figure7. Protégé(<http://protege.stanford.edu/plugins/owl/index.html>) is used to construct an electrical device development ontology and export the corresponding OWL document. Jena RSS package(<http://jena.sourceforge.net/>) is utilised to parse an RSS feed and Jena Ontology API is used to create and parse an OWL document. This section will provide an example of a job finding sensor with the interest shown in Figure5. After the RSS feed from Yahoo Hotjobs is received by the virtual sensor, the concepts defined in ontology are extracted and rearranged into an ontology instance as Figure 4.

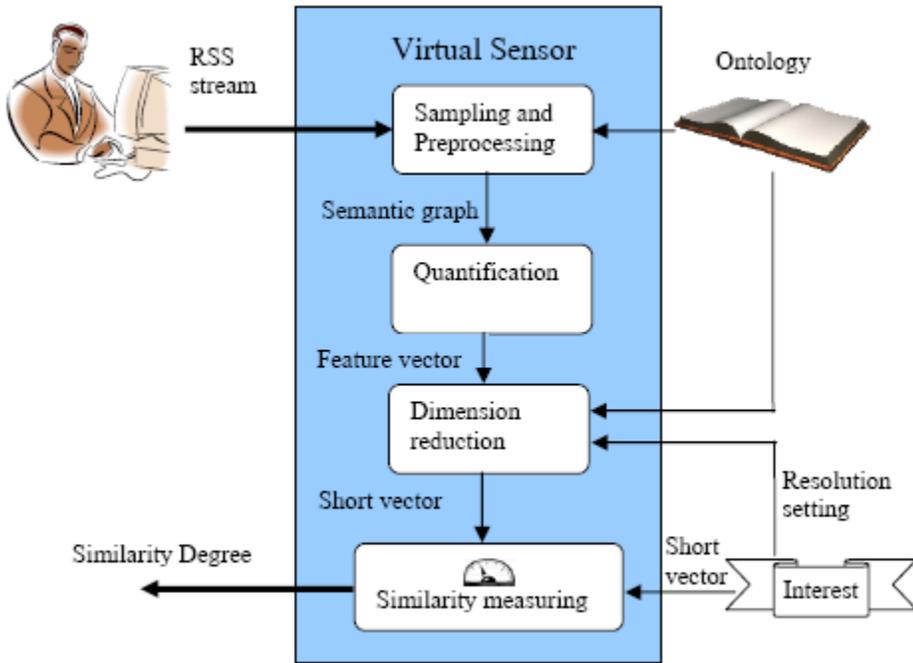


Figure 7. Virtual sensor with variable resolution.

From (2) and (3), the feature vectors of the interest (Figure4) and the RSS feed (Figure3) can be obtained as:

$$V_{intr} = [0, e^{-\alpha}, 0, e^{-2\alpha}, 0, e^{-2\alpha}, e^{-3\alpha}, 0, 0, 0, 0, 0, 0] \tag{5}$$

$$V_{RSS} = [0, e^{-\alpha}, 0, 0, 0, 0, e^{-2\alpha}, 0, 0, 0, 0, e^{-3\alpha}, 0, 0, 0, 0] \tag{6}$$

where $\alpha=1$.

Firstly the semantic distance matrix can be obtained from Figure3 by calculating visual distance [38] between entities, which is a 14*14 matrix.

$$D = \begin{matrix} \begin{bmatrix} 0 & 1 & 1 & 2 & 4 & 3 & 5 & 5 & 4 & 4 & 4 & 2 & 2 & 2 \\ 1 & 0 & 2 & 1 & 3 & 2 & 4 & 4 & 3 & 3 & 3 & 3 & 3 & 3 \\ 1 & 2 & 0 & 3 & 5 & 2 & 6 & 6 & 3 & 3 & 3 & 1 & 1 & 1 \\ 2 & 1 & 3 & 0 & 2 & 3 & 3 & 3 & 4 & 4 & 4 & 4 & 4 & 4 \\ 4 & 3 & 5 & 2 & 0 & 5 & 1 & 1 & 6 & 6 & 6 & 6 & 6 & 6 \\ 3 & 2 & 2 & 3 & 5 & 0 & 6 & 6 & 1 & 1 & 1 & 3 & 3 & 3 \\ 5 & 4 & 6 & 3 & 1 & 6 & 0 & 2 & 7 & 7 & 7 & 7 & 7 & 7 \\ 5 & 4 & 6 & 3 & 1 & 6 & 2 & 0 & 7 & 7 & 7 & 7 & 7 & 7 \\ 4 & 3 & 3 & 4 & 6 & 1 & 7 & 7 & 0 & 2 & 2 & 4 & 4 & 4 \\ 4 & 3 & 3 & 4 & 6 & 1 & 7 & 7 & 2 & 0 & 2 & 4 & 4 & 4 \\ 4 & 3 & 3 & 4 & 6 & 1 & 7 & 7 & 2 & 2 & 0 & 4 & 4 & 4 \\ 2 & 3 & 1 & 4 & 6 & 3 & 7 & 7 & 4 & 4 & 4 & 0 & 2 & 2 \\ 2 & 3 & 1 & 4 & 6 & 3 & 7 & 7 & 4 & 4 & 4 & 2 & 0 & 2 \\ 2 & 3 & 1 & 4 & 6 & 3 & 7 & 7 & 4 & 4 & 4 & 2 & 2 & 0 \end{bmatrix} & \begin{matrix} \text{Electrical Device} \\ \text{Software} \\ \text{Hardware} \\ \text{Programming} \\ \text{Language} \\ \text{Compression} \\ \text{C++} \\ \text{Java} \\ \text{H.26x} \\ \text{MPEG} \\ \text{MP3} \\ \text{Circuit} \\ \text{MCU} \\ \text{Hardware Description Language} \end{matrix} \end{matrix} \tag{7}$$

Based on this distance matrix, HCA is employed to cluster entities and results in a binary concept tree as shown in Figure6. For a given resolution some concepts can be merged to result in a shorter feature vector. For example a very high resolution less than distance 1 requires a full-space matchmaking, i.e. $N=14$. Reducing resolution allows fuzzy attention to find interested information using higher level concepts. For a resolution of distance 1, i.e. the first level in Figure6, entity pairs e_1 and e_2 , e_3 and e_{12} , e_6 and e_9 ,and e_5 and e_7 have similar meanings and are merged to higher-level concepts. A 10 dimensional feature vector can be obtained as:

$$V = \{(e_1 \& e_2), e_4, (e_3 \& e_{12}), e_{13}, e_{14}, (e_6 \& e_9), e_{10}, e_{11}, (e_5 \& e_7), e_8\}$$

where $\&$ is a merging operator.

Further reducing resolution to a distance less than 2 (level 3 in Figure6), the dimension is reduced to 4 and the new short vector is:

$$V = \{((e_1 \& e_2) \& e_4), (((e_3 \& e_{12}) \& e_{13}) \& e_{14}), (((e_6 \& e_9) \& e_{10}) \& e_{11}) \& e_8, ((e_5 \& e_7) \& e_8)\} \tag{8}$$

It can be observed from (7) that the higher-level concepts after the merging, $((e_1 \& e_2) \& e_4)$, $(((e_3 \& e_{12}) \& e_{13}) \& e_{14})$, $(((e_6 \& e_9) \& e_{10}) \& e_{11}) \& e_8$ and $((e_5 \& e_7) \& e_8)$, represent software, hardware, compression and programming language relevant knowledge, respectively. This merging process continues until one single concept remaining, ‘‘Electrical Device’’.

The elements of a short feature vector at a higher level are calculated by a weighted average of two merged low-level entities:

$$e_{l,i} = \omega \cdot e_{l-1,i1} + (1 - \omega) \cdot e_{l-1,i2} \quad (9)$$

where $e_{l,i}$ is the resultant concept on the l -th level; $e_{l-1,i1}$ and $e_{l-1,i2}$ denote two low-level concepts to be merged; ω is a given weight. In this example, $\omega=0.5$.

Considering a level-3 virtual sensor with an attention on (5), where the 14 dimensional interest vectors can be compressed to a 4 dimensional short vector using (8) and (9):

$$V_{intr_s4} = [0.5 \times (0.5e_2) + 0.5e_4, 0, 0.5 \times 0.5 \times 0.5e_6, 0.5 \times 0.5e_7] = [0.1596, 0, 0.0169, 0.0124]$$

Suppose the RSS feed with feature vector (6) is received, the short vector can be obtained as

$$V_{RSS_s4} = [0.5 \times 0.5e_2, 0, 0.5 \times (0.5 \times (0.5e_6) + 0.5e_{10}), 0] = [0.0920, 0, 0.0294, 0]$$

The virtual sensor output is a similarity measure between the two short vectors. It can take Euclidean distance, Chebyshev distance, or Minkowski distance as a metric but cosine angle is widely used for similarity measure:

$$sim(V_{Intr_s}, V_{RSS_s}) = \frac{V_{Intr_s} \cdot V_{RSS_s}}{\|V_{Intr_s}\| \|V_{RSS_s}\|} \quad (10)$$

Therefore, the output of the virtual sensor for the RSS feed can be obtained as

$$sim(V_{Intr_s4}, V_{RSS_s4}) = \frac{V_{Intr_s4} \cdot V_{RSS_s4}}{\|V_{Intr_s4}\| \|V_{RSS_s4}\|} = 0.9702$$

It indicates the received RSS feed is quite similar to the interest in Figure5 and can be used for activation of relevant behaviours.

AN ENERGY DRIVEN SOCIAL BEHAVIOUR NETWORK

In the Internet environment, dynamical users and ambiguous information make a precise cooperative model difficult to be predefined and planned. Traditional workflow based process definition and execution, widely applied in the intranet for VO, would no longer work. It has been observed that the behaviour based paradigm is more suitable to deal with dynamic and unpredictable circumstances, which senses the environment in real-time and act accordingly. However, a difficult issue to organise behaviours is how to take into account both immediate reaction and long-term goals properly. Not only react to emergent events, behaviours should also exhibit goal-driven capability. Energy field in a state space is an ideal representation of action potential covering both local situations and long-term goals. A particularly influential

theory about energy models in the analysis of behaviour was proposed by Lorenz [41]. Though Lorenz’s original psycho-hydraulic model suffered some criticisms [42][43], in the last few years of the twentieth century, many psychologists have suggested that energy concepts still play a useful theoretical role in behaviour analysis[43][44]. Therefore, an energy mechanism for coordination of distributed behaviours is applied in the SoBeNet.

For example, a person is looking for partners and techniques to develop a customised DVR(Digital Video Recorder) with functionality of video files download from the Internet. After searching the Internet, no single company can develop it as a whole but a lot of companies can provide parts of relevant techniques. In this case, what is the most appropriate next action? A behaviour network can help select a candidate for negotiation about a subtask contract. The behaviour network based approach[26] used an activation spreading mechanism for action selection such that: it favours actions that are goal-oriented; it favours actions that are relevant to the current situation; it favours actions that contribute to the ongoing goal/plan. The term of *activation spreading* stands for a kind of energy propagation to address behaviour selection of an agent.

A behaviour network can be represented as a three-layer network, as shown in Figure8: sensor layer, behaviour layer and goal layer. The virtual sensors are located on the sensor layer for perception of interests. A user can set goals or sub-goals at the goal layer. The behaviour layer includes behaviour modules linked by activation or inhibition channels for energy spreading. A behaviour network can be formalised as a tuple (G, M, Π) , where G is a set of goals; M is a set of behaviour modules and Π is a set of parameters that control the energy spreading. An agent executes a behaviour module in M when its activation energy level exceeds an activation threshold defined in Π .

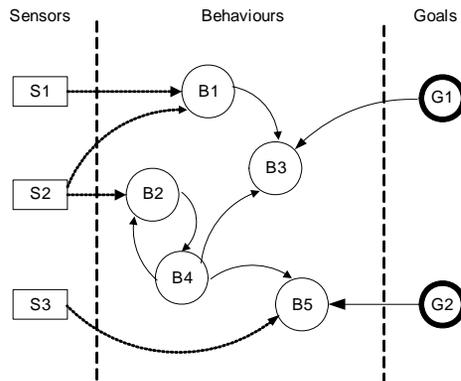


Figure 8. A behaviour network.

Energy control parameters defined in Π are normalised into $[0,1]$ [45], which includes:

- $\gamma \in [0,1]$ activation parameter of module
 $\delta \in [0,1]$ inhibition parameter of module
 $\beta \in [0,1]$ inertia parameter of activation
 $\phi \in [0,1]$ activation parameter of state
 $a \in [0, \bar{a}]$ activation threshold, with \bar{a} the upper bound
 η normalisation constant

The energy control parameters affect the performance of a behaviour network. They could be set by users from their experience or set through a machine learning process.

Each behaviour module M_i in M can be defined by another tuple $(p_i, b_i, Eff_i, h_i, r_i)$ in which b_i represents a functional behaviour, p_i represents a precondition list to be satisfied in order to activate b_i , and r_i is the desired resolution of a virtual sensor. Taking p_i as the interest, the virtual sensor in Figure 7 receives an RSS stream s and generates the degree of behaviour executability, denoted as $\tau(p_i, s)$. A higher resolution expects a more precise check of executability but a lower resolution means a fuzzier condition. $Eff_i := \{eff^+, eff^-\}$ defines a set of effects after execution of the behaviour b_i with eff^+ representing the positive effects and eff^- representing the negative effects, $eff^+ \cap eff^- = \phi$. $Exp(eff^+)$ and $Exp(eff^-)$ denote the expectations of energy injection from eff^+ and eff^- to a linked behaviour respectively. The value h_i denotes the activation energy level of b_i , accumulated from goals or other modules. When the activation energy level exceeds activation threshold $a_i \in \Pi$, the behaviour can be activated.

Energy flows through links between behaviour modules. Suppose there is a link from behaviour A to behaviour B . B is called a successor of A if A has a positive effect (eff^+) that is in the proposition of the B 's precondition, whilst A is called a predecessor of B . There is a conflicting link from A to B if A has a negative effect (eff^-) that is in the proposition of the B 's precondition.

A behaviour module can take energy from current states and final goals, directly or indirectly. A direct acquisition means energy obtained from the current sensors and goals, whilst an indirect acquisition means energy obtained from other behaviour modules.

Energy from states

- direct acquisition

An agent detects interested RSS feeds via its virtual sensors. A certain amount of energy proportional to the similarity between p_i and a perceived state s_j will be injected to the

behaviour module i . The behaviour will be activated only if its activation energy level exceeds its activation threshold a_i . Therefore, the directly acquired energy at step T is:

$$h_{i,s_j,1}^T = \phi \cdot \tau(p_i, s_j) \cdot \text{Exp}(eff^+) \quad (11)$$

- indirect acquisition

If a behaviour module is not executable, it will transfer its energy to its predecessors for inciting its activation. M_i as a predecessor can acquire energy from the not executable successor:

$$h_{i,s_j,2}^T = \gamma \cdot \sigma(h_i^{T-1}) \cdot \text{Exp}(eff^+) \cdot (1 - \tau(p_{succ}, s_j)) \quad (12)$$

An executable behaviour module will share part of its own energy to its successors, proportional to the unsatisfied degree between the precondition of its successors and the current state. Therefore M_i as a successor acquires energy from the executable predecessor:

$$h_{i,s_j,3}^T = -\gamma \cdot \sigma(h_i^{T-1}) \cdot \text{Exp}(eff^+) \cdot (1 - \tau(p_i, s_j)) \quad (13)$$

where $\sigma(\bullet)$ is an energy transfer function between modules.

For a conflicting link, energy of a behaviour module which has a negative effect (eff^-) on a behaviour will be absorbed by the affected behaviour, proportional to the unsatisfied degree of the affected behaviour:

$$h_{i,s_j,4}^T = -\delta \cdot \sigma(h_i^{T-1}) \cdot \text{Exp}(eff^-) \cdot (1 - \tau(p_{conf}, s_j)) \quad (14)$$

Energy from goals

- direct acquisition

Goal g_i injects energy to those behaviours whose eff^+ is in the g_i :

$$h_{i,g_i,1}^T = \gamma \cdot \tau(eff^+, g_j) \cdot \text{Exp}(eff^+) \quad (15)$$

Goal g_i extract energy from those behaviours whose eff^- is in the g_i :

$$h_{i,g_i,2}^T = -\delta \cdot \tau(eff^-, g_j) \cdot \text{Exp}(eff^-) \quad (16)$$

- indirect acquisition

As (12), (13) and (14), indirect energy spreading is through predecessor-successor links or conflict links, which could be due to g_i . The indirect energy spreading reflect a key characteristic of behaviour networks that behaviours that currently cannot be executed spread activation energies backwards to predecessor behaviours addressing sub-goals.

Finally all energy components will be summed up and pass through a low-pass filter for generating a smooth energy flow:

$$h_i^T = \beta \cdot h_i^{T-1} + (1 - \beta) \cdot \sum_{k,j} (h_{i,g,jk}^T + h_{i,s,jk}^T - h_{i,indi}^T) \quad (17)$$

where $h_{i,indi}^T$ represents the indirectly extracted energy from M_i by the linked behaviours following (12),(13) and (14).

Execution of a behaviour network is carried out by repeatedly scanning activation energy in individual behaviour modules. For each step, only the behaviour with highest energy level will be activated. The pseudo code can be presented as follows:

Loop forever:

- Compute direct activation energy.
 - Add activation from goals and environment.
- Spread indirect activation energy among behaviours.
 - Forward energy via successor links.
 - Backward energy via predecessor links.
 - Backward energy via conflict links.
- Normalise behaviour energy levels in the network:

$$h_k^T(0) = \eta \frac{h_k^{T-1}}{\sum_{k=1}^n h_k^{T-1}}.$$

- Behaviour i is fired if:
 - Its activation level is over the threshold a_i .
 - Its activation level is highest in all behaviours.
- If one behaviour is fired,
 - Its energy level is reset to zero.
 - Threshold value is reset to default.
- If no behaviour fired, reduce threshold a_i by x%.

IMPLEMENTATION OF OF SOBENET AND AND EXPERIMENTAL ILLUSTRATION

The SoBeNet is a distributed multi-agent system to support social interaction in the Internet. Each agent defines its local behaviour networks but does not need to specify cooperation models with others, which could be too unpredictable and ambiguous to be modelled. The social interaction among agents happens emergently by information exchange.

Therefore it is a bottom-up approach for organisation of distributed agents. In order to validate its capability to interact in a constantly changed and unpredictable environment, a SoBeNet software platform was developed using the JADE(Java Agent Development Framework), which was developed by Telecom Italia Lab and in compliance with the FIPA(Foundation for Intelligent Physical Agents) specifications. As the JADE architecture is based on a highly extendable Java architecture, this allows us to easily extend the architecture to incorporate our SoBeNet functionality. JADE is open source. It is efficient and scalable for large multi-agent systems[45] and flexible to network topology in fixed and mobile environments[46]. JADE provides support for automatic document exchange in XML and RDF[46].

Each running instance in the JADE is a container, which could include one or more agents. The set of active containers constitutes a platform, where only a single main container can be active for the administration and coordination purposes through AMS(Agent Management System) and DF(Directory Facilitator). Distributed agents can communicate each others through asynchronous messages in the ACL(Agent Communication Language). The architecture of the software platform is shown in Figure 9. The main container includes a blackboard agent in addition to the AMS and the DF. It is the virtual state space to depict the environment and the information sources monitored by virtual sensors. The blackboard agent receives RSS feeds subscribed by user agents and provides a common space for information exchange among agents, which includes RSS data regions, domain ontology, agent ID's and a message routing table. Each normal container representing a user includes a sensor agent S_i and a controller agent C_i . The sensor agent implements the proposed virtual sensor. A user is allowed to subscribe RSS feeds, define interests, and configure sensor parameters, i.e. resolution. The controller agent maintains a set of behaviour modules extending the behaviour class of JADE to form a local behaviour network. Each behaviour module is implemented in its action() method and activated by energy from virtual sensors and other behaviours. The user is allowed to configure the controller agent, e.g. energy spreading parameters and activation threshold. Note that each user can also receive RSS feeds from its sensor agent and publish information update in RSS by its controller agent directly, rather than via the Bblackboard agent. Due to lack of websites allowing bi-directional and interactive RSS information exchange today, in this paper, we use the blackboard agent as a common information pool for carrying out interactive RSS information exchange.

In addition to JADE, the following software tools are used for the implementation:

- Protégé OWL(<http://protege.stanford.edu/overview/protege-owl.html>) for construction of ontology;
- Jena Ontology API (<http://jena.sourceforge.net/ontology/index.html>) for parsing and reasoning OWL documents;
- ROME(<https://rome.dev.java.net/>) + JDOM(<http://www.jdom.org/>) for parsing, generating and publishing RSS feeds.

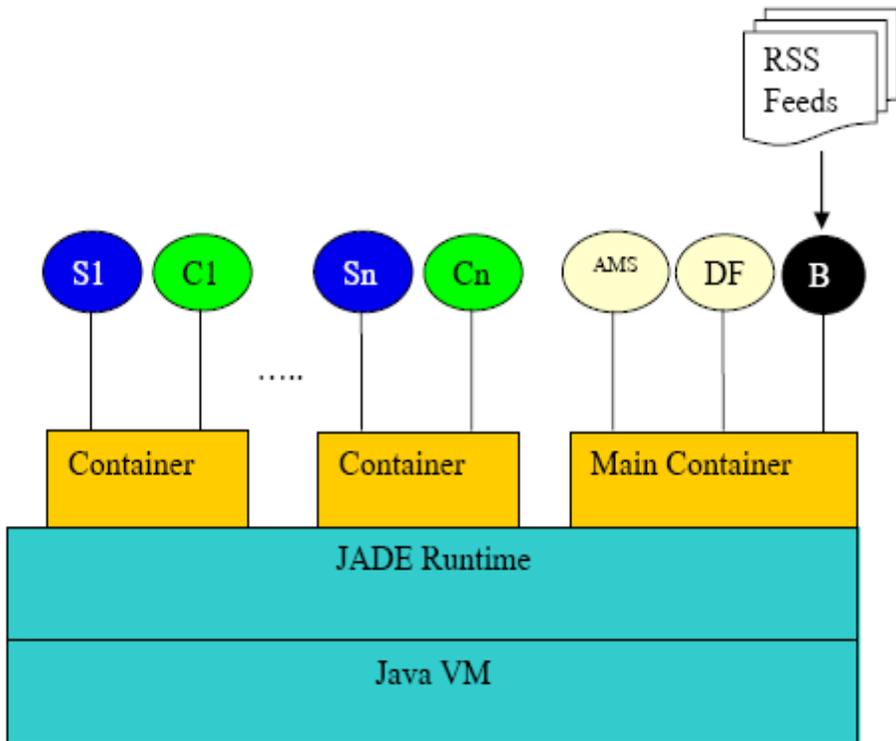


Figure 9. Software architecture of the SoBeNet.

To illustrate the effectiveness of the SoBeNet, we undertook a case study based on a scenario of virtual organisation for DVR(Digital Video Recorder) development. A DVR is a consumer video/audio product that can record and play video/audio using different compression standards. The storage media includes hard disks and recordable CD/DVD disks. In this scenario, a development leader intends to recruit some competent candidates to join the team while some job hunters are looking for jobs via RSS feeds of job websites. Without any previous interaction experience, it will be shown that how appropriate people can be self-organised by independently developed behaviour nets.

Virtual Sensors

Virtual sensors in different community need different domain ontology. When a user registers onto the JADE platform, its virtual sensor agents download the domain ontology from the blackboard agent automatically. An ontology including 70 concepts for DVR development was defined using Protégé-OWL and the OWL file was stored in the blackboard agent. Figure10 shows the user interfaces for configuration of a virtual sensor. A user registered to the SoBeNet as Tom and subscribed RSS feeds from Yahoo hotjobs (<http://hotjobs.yahoo.com/rss/0/USA/-/-/IT>), UK academic employment (<http://www.jobs.ac.uk/rss/disc/2516.xml>), and CareerBuilder (http://rtq.careerbuilder.com/RTQ/rss20.aspx?lr=cbc_b_ctandrssid=cb_ct_rss_enginandcat=JN004andstate=ILandcity=chicago)

for job searching. A user profile, “I am a software developer, mastering C, Java and SQL. I have three years web programming experience”, was announced as the virtual sensor interest. The parameters of the virtual sensor were set, which specifies a sensor resolution of 56% and output of top 10 candidates. A running example of this virtual sensor is shown in Figure 11, where candidates were identified and the match degrees can be sent to the virtual control for behaviour activation.

Virtual Controllers

A controller agent manages a behaviour network for its local goals. As a job hunter, its goal is to “find a job for the user” and the following behaviour modules are defined:

Match-Job:

Action: notify the user

Precondition list: the job list and match degrees received from the virtual sensor

Add list: Candidate-job

Delete list: No-fitted-job

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Delete list: No-fitted-job

Apply-job:

Action: send an application

Precondition list: Candidate-job, User-confirmed

Add list: Job-applied

Delete list: No-fitted-job

Modify-job-description:

Action: new interest setting for the virtual sensor

Precondition list: No-fitted-job, Time-out

Add list: Personal-Job-Description

Delete list:

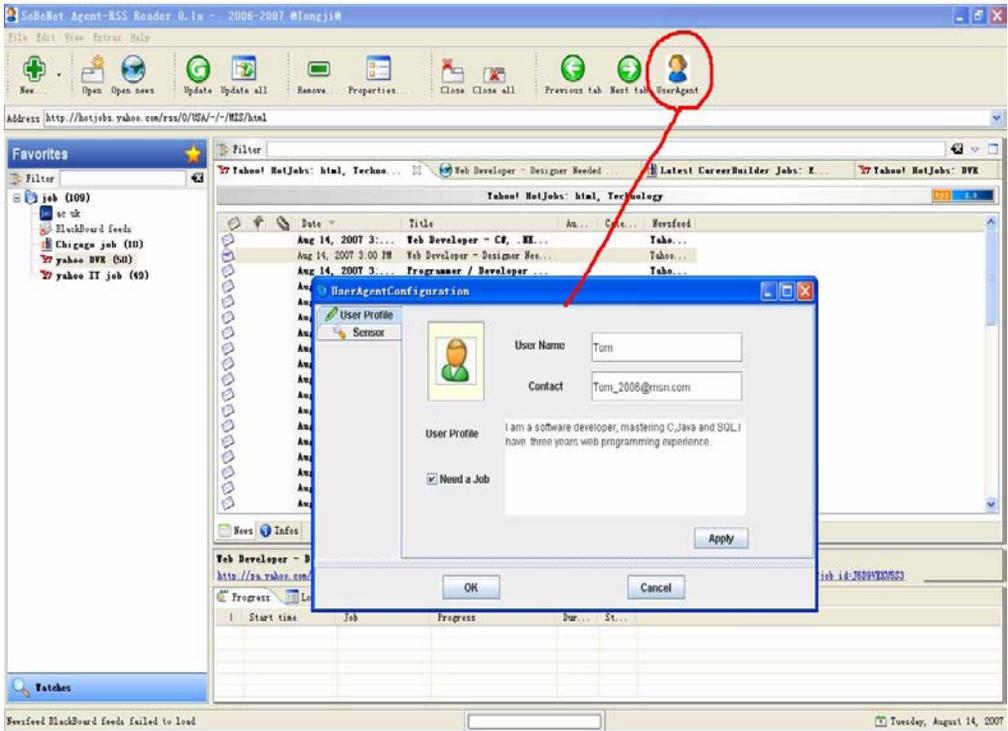


Figure 10. Virtual sensor registration.

MatchDegree	Title
54%	Sr. SW Engineer Java, J2EE, JDBC, Web Services, PHP, C, C++, XML, S...
54%	quot;C quot; Developer - Platinum IT / Platinum I.T - Port Washington, N...
52%	Perl Developer - Perl C SQL - C2K Technologies - San Francisco, CA USA
52%	Java Engineering Team - Portland area - Formalized Design, Inc - Portla...
46%	Software Engineer - TiVo Inc. - San Jose, CA USA
46%	C / SQL Developer - Quest Software, Inc. - Madison, WI USA
45%	C, C++ or Java Developers (3 needed) - Career Doctor - Burlington, NJ ...
44%	SQL Developer - Systems Integration and Development - Washington, D...
43%	SQL SERVER DEVELOPER - Conquest Associates, LLC - New York, NY...
43%	Infrastructure C / C++ Developer - TheLadders.com, Inc. - New York, NY ...

Figure 11. Virtual sensor output

The agent will receive interested jobs from the virtual sensor continuously and then apply for a job closing enough to its interest. If no fitted job appears, the job description will be modified.

At the same time, some head hunters intend to recruit team members for their development jobs. The goal is to “issue an offer to a competent applicant”. Two behaviour modules are defined for a head hunter:

Publish-job

Action: publish vacancies in RSS

Precondition list: Vacancy-appear

Add list: Position-description

Delete list:

Match-Candidates (Choose proper person) :

Action: match applicant and Issue an offer

Precondition list: RSS-job-application-feeds, Position-description

Add list: Candidate-chosen

Delete list:

The agent will publish job description in RSS and wait for applications. Once a competent applicant appears, it will notice the user as a head hunter and the user will confirm if the job should be offered.

Therefore, job-hunters and head-hunters are independent individuals in the Internet. They only define their local goals and behaviours. The social interaction for organising a development team is completed naturally by generated events, from virtual sensors, timers and user keyboards. The behaviour networks for job-hunter and head-hunters and the energy flow are shown in Figure12.

As lacking of an overall process model, the dynamic consequence of a behaviour network could be less predictable and depend on network parameters. However, it can often take reasonable actions at a right time, although not optimum. For a complex and distributed system, optimisation in terms of all agents would become less sense, if not impossible. Achieving individual goals can lead to high level social interaction and satisfy high level social goals. Maes gave several suggestions about how to tune the parameters[47][48]. Due to variable topology and variable scale of a behaviour network, it is difficult to have a general principle for parameter setting[49] and the trail-and-error method has been generally used. Taking the values proposed in [49] as a reference, the parameters are set to be $\phi = 0.5, \gamma = 1.2, \delta = 1.5, \beta = 0.5, \hat{a} = 3, \eta = 10$ in the following simulation.

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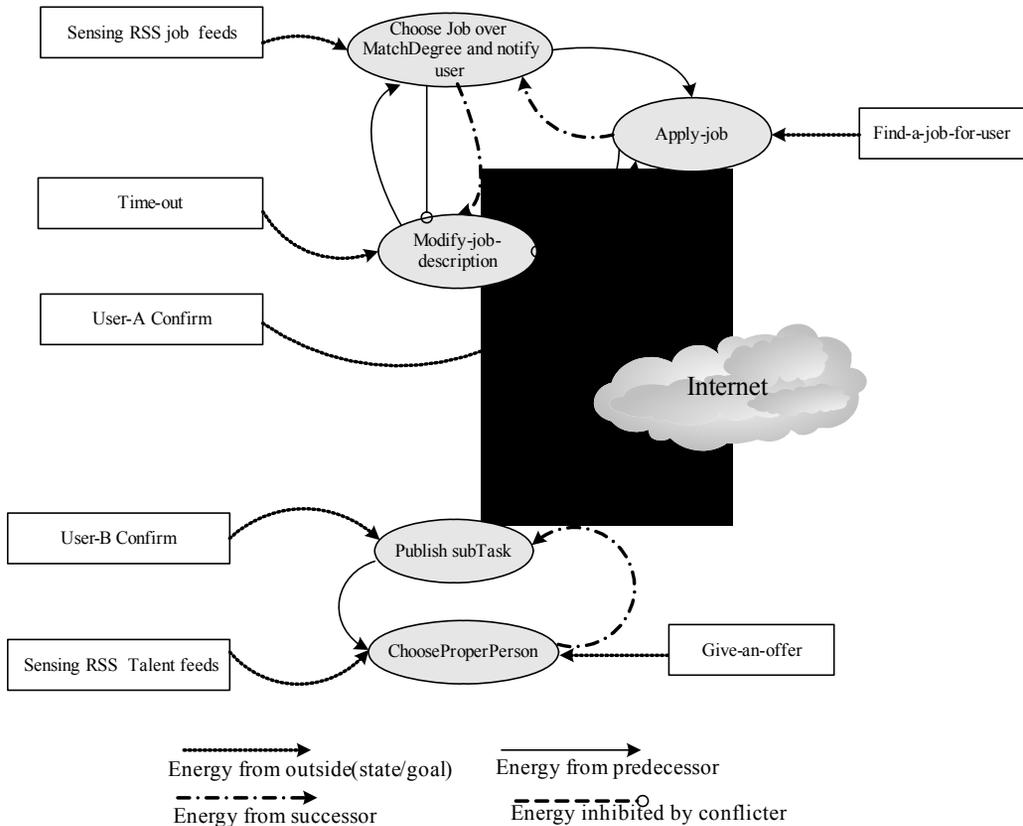


Figure 12. Behaviour networks for social interaction.

In this section, social interaction and self-organisation capability of the SoBeNet will be verified. Suppose there are 20 SoBeNet agents that are either job-hunters for getting a job or head-hunters for recruiting a person for a project. The role of a user is not unchanged, who can register as a job-hunter for getting a task first and then decompose the job into subtasks to become a head-hunter for subcontracting. Due to the dual roles of each user, a hierarchical virtual organisation can be formed[31]. Whenever, as a job-hunter or as a head-hunter, the corresponding behaviour networks shown in Figure12 will be used for driving its actions. The information sources are come from job RSS feeds including websites of Yahoo Hotjobs, UK Academic Jobs, and CareerBuilder. Because no RSS feeds available today for personal ability or talent announcement, a simulated RSS source is created in the blackboard agent, which is obtained by inserting user names to job descriptions received from the job websites.

The simulation starts from a user registering as a head-hunter for development of a DVR project (Figure13). The goal is to subcontract to others for software and hardware development. After execution of the publish-job behaviour, position-description is added and match-candidates behaviour is activated. Through the virtual sensor, the top 3 candidates are Sam, Nick, and Jack and the best matched person is Sam with a match degrees of 0.439, whose personal description from the RSS feeds is “\$Title: DVR project \$Description: ... system architecture. Master the knowledge of software and hardware design.”. Therefore the job is offered to Sam. Sam then divides the job into subtasks as in Figure14 and becomes

head-hunter for the subtasks, hardware development and software development. The candidates with highest similarity, Jerry and Andy, are selected by the Match-job behaviour and invited to join the team. Andy refused the invitation for “hardware development” and Jack with the second highest similarity was recruited into the team. This task-reallocation process is repeated until no further division as shown in Figure15. The final virtual organisation for DVR development is shown in Figure16.

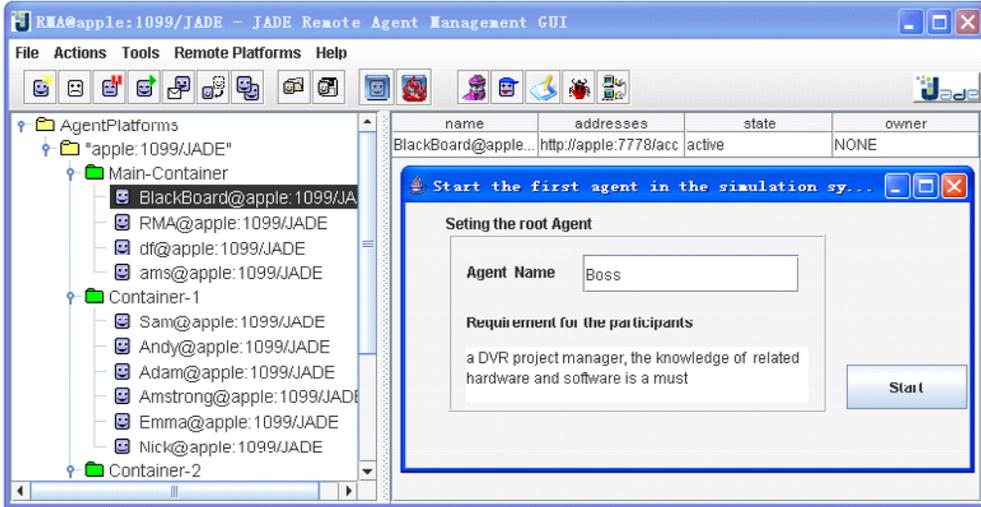


Figure 13. SoBeNet simulation platform.

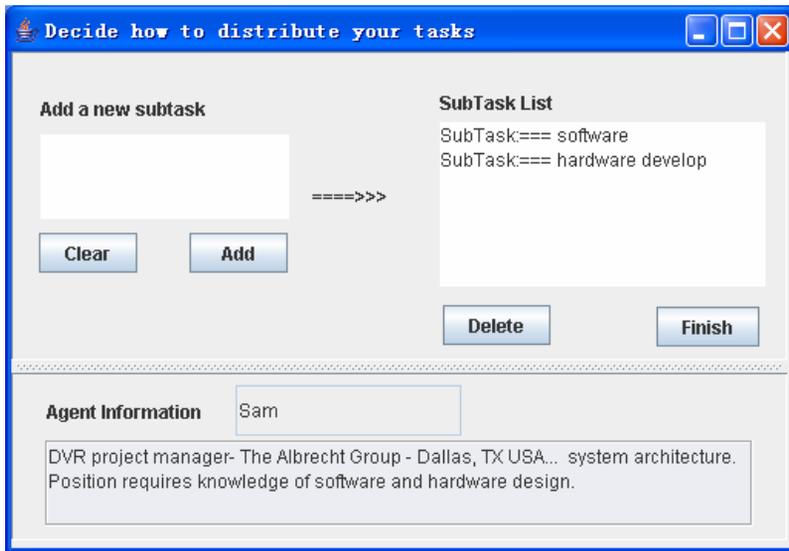


Figure 14. Task reallocation.

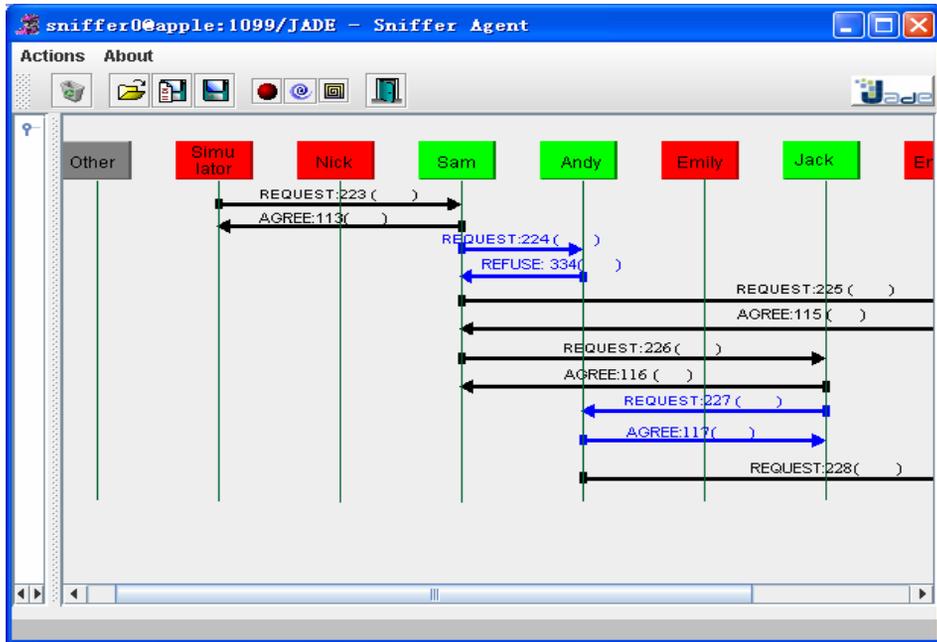


Figure 15. Interaction diagram.

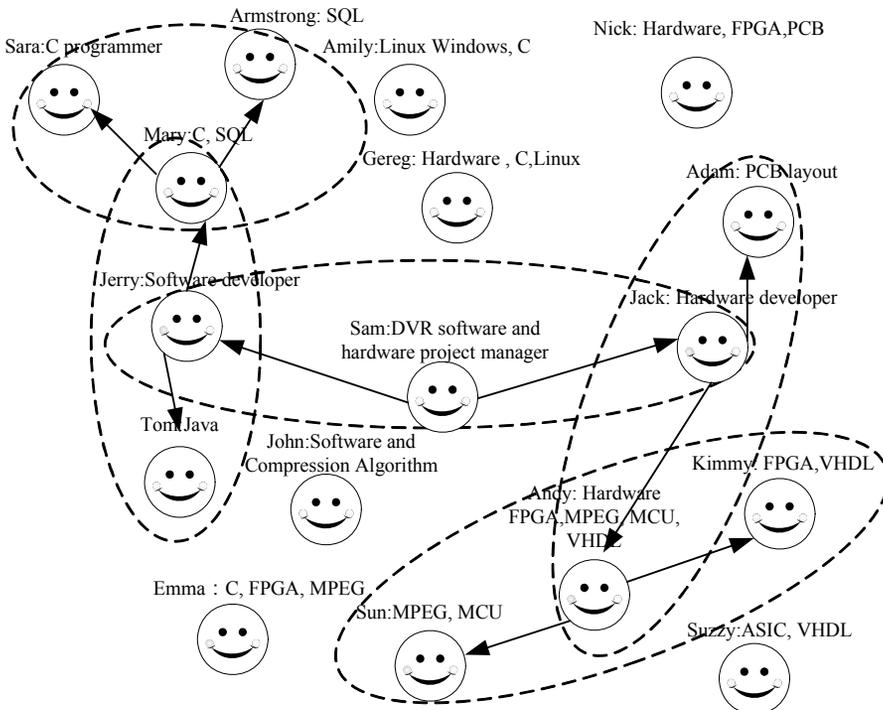


Figure 16. Self-organisation for DVR development.

It is shown from the simulation that each agent does not know other agents in advance and performs independently according to sensed information. Social interaction happens naturally by activating distributed local behaviours. It is more suitable for interaction in dynamic and uncertain environments than the traditional model based approaches.

CONCLUSIONS

This chapterpaper presented the SoBeNet architecture and implementation for social interaction through the Internet, which may involve unpredictable uncertainties and unknown participants. The social interactions on the Internet are often characterised by a set of organisations or individuals who come together to perform an intellectual focussed project over some period of time. It is often difficult to adapt the traditional process model based approaches should a rethink or problem arise in mid-project. In the SoBeNet, each person is aided by a software agent which embeds semantic sensors and a behaviour net. The behaviour nets manage all agent actions enabling them to achieve individual goals at the same time allowing them to react to changes in the Internet e.g. the alteration of a behaviour mid-project or the replacement of a project partner. The social interaction is thus spontaneous. A test bed of the SoBeNet was developed by using the Java-based JADE techniques and was operated using familiar Internet tools. The virtual organisation for DVR development was taken as the simulation scenario. It demonstrated that dynamic nature of VOs i.e. the fact that partners may leave mid-project and others sought, can be better addressed by the SoBeNet in which agents sense such changes and act automatically to fix these problems.

REFERENCES

- [1] Aerts, A.T.M., N.B. Szirbik, and J.B.M. Goossenaerts, "A flexible, agent-based ICT architecture for virtual enterprises," *Computers in Industry*, 49, 311-327, 2002.
- [2] Martinez, M.T., K.H. Park, and J. Favrel, "Virtual enterprise: organisation, evolution and control," *Int. J. Production Economics*, 74, 225-238, 2001.
- [3] Camarinha-Matos, L. M., H. Afsarmanesh, "Elements of a base VE infrastructure", *Computers in Industry*, 51, 139-163, 2003.
- [4] Burn, J., P. Marshall, M. Barnett, *E-business Strategies for Virtual Organizations*, Elsevier, Kent, UK, 2002.
- [5] Foster, I., C. Kesselman, S Tuecke, "The anatomy of the grid: enabling scalable virtual organizations," *Int. J. High Performance Computing Applications*, 15, 200-222, 2001.
- [6] EC DataGrid, "VOMS vs EDG security requirements," Work Package 6, 2002.
- [7] EC ECOLEAD, "Challenges in virtual organisations management," D32.1, Work Package 3, 2004.
- [8] Norman, T. J., A. Preece, et al., "Agent-based formation of virtual organizations," *Knowledge-Based Systems*, 17, 103-111, 2004.
- [9] Goldman, C. V. and J. S. Rosenschein, "Evolutionary patterns of agent organizations," *IEEE Trans. Systems, Man, And Cybernetics—Part A*, 32, 135-148, 2002.

-
- [10] Subbu, R. and A. C. Sanderson, "Network-based distributed planning using coevolutionary agents: architecture and evaluation," *IEEE Trans. Systems, Man, And Cybernetics—Part A*, 34, 257-269, 2004.
- [11] Russell, S. and P. Norvig, *Artificial Intelligence: A Modern Approach*. Prentice Hall, Upper Saddle River, New Jersey, second edition, 2003.
- [12] Kurbel, K. and I. Loutchko, "A model for multi-lateral negotiations on an agent-based marketplace for personnel acquisition," *Electronic Commerce Research and Applications*, 4, 187-203, 2005.
- [13] Hishiyama, R. and T. Ishida, "Modeling e-procurement as co-adaptive matchmaking with mutual relevance feedback," M.W. Barley and N. Kasabov (Eds.): *PRIMA 2004*, LNAI 3371, 67–80, Springer, 2005.
- [14] Trastour, D., C. Bartolini, C. Preist, "Semantic web support for the business-to-business e-commerce pre-contractual lifecycle," *Computer Networks*, 42, 661–673, 2003.
- [15] Ludwig, S. A. and S.M.S. Reyhani, "Introduction of semantic matchmaking to grid computing," *J. Parallel Distrib. Comput.*, 65, 1533-1541, 2005.
- [16] Avancha, S., A. Joshi, T. Finin, "Enhanced service discovery in Bluetooth," *Communications*, 96-99, 2002.
- [17] Ludwig, S. A. and S.M.S. Reyhani, "Semantic approach to service discovery in a grid environment," *Journal of Web Semantics*, 4, 1-13, 2006.
- [18] Colucci, S., T. D. Noia, E. D. Sciascio, F. M. Donini, M. Mongiello, "Concept abduction and contraction for semantic-based discovery of matches and negotiation spaces in an e-marketplace," *Electronic Commerce Research and Applications*, 4, 345-361, 2005.
- [19] Stoilos, G., G. Stamou, V. Tzouvaras, J.Z. Pan, I. Horrocks, "The fuzzy description logic f-SHIN," *International Workshop on Uncertainty Reasoning For the Semantic Web*, 2005.
- [20] Pan, J. Z., G. Stoilos, G. B. Stamou, V. Tzouvaras, I. Horrocks. "f-SWRL: a fuzzy extension of SWRL," *Journal on Data Semantics*, 6, 28-46, 2006.
- [21] Saven, R. S. A., "Business process modelling: review and framework," *Int. J. Production Economics*, 90, 129-149, 2004
- [22] Stuit, M., N. Szirbik, "Interaction beliefs - a way to understand emergent organizational behaviour," *ICIES*, 2007.
- [23] Yan, Y. , Z. Maamar, W. Shen, "Integration of workflow and agent technology for business process management," *CSCWD-01*, 420- 426, 2001
- [24] Brooks, R.A., "Intelligence without Representation," *Artificial Intelligence*, 47, 139-159, 1991.
- [25] Arkin, R.C., *Behavior-based Robotics*, MIT Press, Cambridge, MA, 1998.
- [26] Maes, P., "Situated agents can have goals," *Robotics and Autonomous Systems*, 6, 49-70, 1990.
- [27] Song, H. and S. Franklin, "A behaviour instantiation agent architecture," *Connection Science*, 12, 21–44, 2000.
- [28] Zhang, Z., S. Franklin, D. Dasgupta, "Metacognition in software agents using classifier systems," *15th National Conference on Artificial Intelligence*, 83-88, Madison WI, 1998.

-
- [29] Nebel, B., Y. Lierler, "Goal-converging behavior networks and self-solving planning domains: how to become a successful soccer player", 16th European Conference on Artificial Intelligence, 2004.
- [30] Jiang P, Q. Mair, J. Newman, "The application of UML to the design of processes supporting product configuration management," *International Journal of Computer Integrated Manufacturing*, 19 (4), 393-407, 2006.
- [31] Jiang, P., Q. Mair Q., Z. Feng, "Agent alliance formation using ART-networks as agent belief models," *Journal of Intelligent Manufacturing*, 18 (3): 433-448, 2007.
- [32] Wegrzyn-Wolska, K. and P. S. Szczepaniak, "Classification of RSS-formatted documents using full text similarity measures," In Proceedings of the 5th International Conference on Web Engineering (ICWE2005), Sydney, Australia, 400-405, 2005.
- [33] Prabowo, R. and M. Thelwall, "A comparison of feature selection methods for an evolving RSS feed corpus," *Information Processing and Management*, 42(6), 1491-1512, 2006.
- [34] Glance, N. S., M. Hurst, T. Tomokiyo, "BlogPulse: automated trend discovery for weblogs," Proceedings of the 13th International WWW Conference: Workshop on Weblogging Ecosystem: Aggregation, Analysis and Dynamics, New York, USA, 1-8, 2004.
- [35] Yang, Y. and J. O. Pedersen, "A comparative study on feature selection in text categorization," In Proceedings of the Fourteenth International Conference on Machine Learning (ICML 1997), San Francisco, USA, 412-420, 1997.
- [36] Williams, J. and N. Steele, "Difference, distance and similarity as a basis for fuzzy decision support based on prototypical decision classes," *Fuzzy sets and systems*, 131, 35-46, 2002.
- [37] Sycara, K., M. Klusch, S. Widoff, J. Lu, "Dynamic service matchmaking among agents in open information environments," *ACM SIGMOD Record*, 28, 47-53, 1999.
- [38] Akoka, J. and I. C. Wattiau, "Entity-relationship and object-oriented model automatic clustering," *Data and Knowledge Engineering*, 20, 87-117, 1996.
- [39] Saridis, G.N., "Analytical formulation of the principle of increasing precision with decreasing intelligence for intelligent machines," *Automatica*, 25, 461-467, 1989.
- [40] Kaufman, L. and P.J. Rousseeuw, *Finding Groups in Data: an Introduction to Cluster Analysis*. New York: John Wiley and Sons, 1990.
- [41] Lorenz, K., "über die Bildung des Instinkt Begriffes," *Naturwissenschaft*, 25, 289-300, 307-318, 324-331, 1937.
- [42] Hinde, R. A., "Energy models of motivation," *Symp. Soc. Exp. Biol.*, 14, 199-213, 1960.
- [43] Hogan, J.A., "Animal behavior," *Foundations of Psychology*, Copp Clark Pitman, Toronto, 138-186, 1996.
- [44] Hogan, J. A., "Energy models of motivation: a reconsideration," *Applied Animal Behavior Science*, 53, 89-1005, 1997.
- [45] Chmiel, K., M. Gawinecki, P. Kaczmarek, M. Szymczak, M. Paprzycki, "Efficiency of JADE agent platform," *Scientific Programming*, 13, 1-14, 2005.
- [46] Bellifemine, F., G. Caire, A. Poggi, G. Rimassa, "JADE: a white paper," *EXP*, 3(3), 6-19, 2003.
- [47] Maes, P., "The dynamics of action selection," Proceedings of IJCAI-89, 991-997, San Mateo, CA: Morgan Kaufmann, 1989.

-
- [48] Maes, P., “Adaptive action selection,” Proceedings Thirteenth Annual Conference of the Cognitive Science Society, 108–113. Hillsdale, NJ: Lawrence Erlbaum, 1991.
- [49] Tyrrell, T., Computational Mechanisms for Action Selection. PhD thesis. In-House Publication (technical report) no. EUCCS/PHD 72, Centre for Cognitive Science, University of Edinburgh, 1993.

Chapter 4

**ADVANTAGES AND PITFALLS OF SOCIAL
INTERACTIONS IN THE DIGITAL AGE: PRACTICAL
RECOMMENDATIONS FOR IMPROVING VIRTUAL
GROUP FUNCTIONING**

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ABSTRACT

The recent technological advances and the exponential growth of the Internet have multiplied the opportunities for forming virtual relationships. Today, people can come together in the same virtual space or "cyberspace". They can communicate with their family or friends on-line, encounter new people through computer-mediated communication (CMC) and also learn or work in virtual groups. There is no doubt that a better understanding of how people use computers and communication technologies to work together and learn at a distance will be a major challenge for the coming years. Many terms have been used to describe the digital environments for collaboration in geographically dispersed teams such as CSCL (Computer-Supported Collaborative Learning), CSCW (Computer-Supported Cooperative Work) or CSGBL (Computer-Supported Group-Based Learning). The objective of the present chapter is to examine the functioning of virtual learning or working groups. First, the effect of reduced auditory and visual cues in CMC on collaboration between members of dispersed teams will be examined. These new digital environments are in fact supposed to facilitate collaboration at a distance allowing remote interactions between members of a group. However, some

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studies have also found some negative effects of distance in collaborative learning/working groups. After examining these different effects, some recommendations are made for improving the functioning of virtual groups.

INTRODUCTION

Today, digital technologies enable new forms of social interaction to be expressed in which people can come together in the same virtual space, or “cyberspace”, while being physically located in different places. For some, it will just involve having a conversation, meeting new people, or taking part in shared activities. For others, it means exchanging and sharing ideas, skills or knowledge, for either professional or leisure purposes. Virtual meeting places provide the possibility of developing new social groups whose objectives and motives are often very different. The novelty of these places is that for the first time in the history of science and technology interactions are no longer restricted to communication between people and technology, but extend to interactions between physically separated users via a network of connected computers. The exponential development of information and communication technologies has fostered the emergence of communities, groups and teams whose members do not work face-to-face but interact at a distance using electronic communication tools. In general, the term “virtual group” is used to define a group of people physically and/or organizationally separate who use technological tools to carry out a common task, with infrequent face-to-face meetings. From this point of view, virtual groups can be considered as temporary or permanent structures which use traditional technologies such as e-mail, instant messaging, chat-rooms, online audio- or video-conferencing, but also more sophisticated technologies such as virtual classrooms, Group Support Systems (GSS), virtual reality (VR) or augmented reality (AR). A large number of terms have been used to describe the digital environments dedicated to mediatized communication and collaboration, such as Computer-mediated Communication (CMC), Computer-Supported Collaborative Learning (CSCL), Computer-Supported Cooperative Work (CSCW), or Computer-Supported Group-Based Learning (CSGBL), to name but a few.

These digital environments are supposed to make distance collaboration easier by allowing group members to interact even when they are physically apart. Knowing how people use computers and communication technologies to work and learn together at a distance is a major objective for the future. The advantages and disadvantages of these new forms of social interaction which use communication technologies will need to be identified so that practical recommendations can be made to improve the organization and functioning of virtual groups.

THE ADVANTAGES

The main advantage lies in removing the constraints of time and space. With asynchronous communication, individuals can contribute when and where it suits them, thereby reducing the problems of coordination associated with the frequent problem of incompatible schedules. From the organization’s perspective, travel expenses can be reduced (transport, accommodation) as well as running costs (office rental, electricity), because their

employees can work anywhere. From the employee's perspective, time or psychological pressures can be reduced, as can the time lost in very (too) frequent face-to-face meetings

(Rogelberg, Leach, Warr, and Burnfield, 2006). In some cases, the physical absence of other people in virtual team work can improve the performance of difficult tasks by reducing stress, sources of distraction, the loss of private space, and the apprehension of being judged by others, which are often features of traditional teams (Kiesler and Cummings, 2002).

Other advantages can also be found in the way communications are structured. The lack of social cues in electronic communication environments puts group members on an egalitarian and equitable footing, in particular by removing behavioral inhibitions and reducing pressure to conform with the group (Bordia, 1997; Dubrovsky, Kiesler, and Stehna, 1991; Straus and McGrath, 1994). For example, people have been observed to contribute more to chat-room sessions than in face-to-face conversations (McDaniel, Olson, and Magee, 1996). However, other studies have produced contrary results, showing that status and power relationships do not become more egalitarian with electronic communication, but conversely, become stronger (Postmes, Spears, and Lea, 1998). These differences can be explained by the fact that different studies give more or less prominence to differences in status (or other characteristics). Research carried out within the framework of the SIDE model (*Social Identity of Deindividuation Effects*; Spears and Lea, 1992; 1994; Reicher, Spears, and Postmes, 1995) provides some empirical support for this hypothesis. According to this model, the anonymity of computer-mediated communication environments (i.e. absence of non-verbal and paralinguistic clues, use of pseudo-communication, absence of co-presence) increases the feeling of belonging to a group. More specifically, the central factor is the degree to which a particular group (or social category) is given salience for the individuals with the specific norms associated with that group (or social category). When the context provides clues bringing out a sense of categorial membership (e.g. Mac or PC users, Linux or Windows users), that can be enough to create a sense of belonging to the group, leading individuals to see themselves as members of that group and identify with it.

In an experimental study, Lea, Spears and De Groot (2001) observed a stronger identification and greater attraction towards the group under a visually anonymous condition than under a condition of identification using a simple silent webcam. Likewise, digital environments which give personal information about the participants (e.g. "who's who" type biographies) decrease the group identification and have a negative effect on online collaboration and social interactions (Lea, Rogers, and Postmes, 2002). In other words, in environments in which social interactions are mediated by computer, the personal identity of the individual is replaced by a depersonalized social identity which fosters greater social cohesion and attraction towards the group (Michinov and Monteil, 2003). From this standpoint, we have shown experimentally that identification with a virtual learning group can be created from a simple categorization of the learners on the basis of an arbitrary criterion, and above all, by inter-group comparison (Michinov, Michinov, and Toczek-Capelle, 2004). The results of this experiment show that when belonging to a group is enhanced through use of a "pseudo group" rather than a "pseudo individual", coordination activities are more efficient, there are more interactions directed towards carrying out the task and maintaining social relationships, and the learners take longer to provide personal information, a sign of stronger social cohesion.

THE PITFALLS

At least three pitfalls have recently been identified as significant hindrances to virtual team work by Thompson and Coovert (2006): communication difficulties, the lack of mutual awareness, and failure to develop interpersonal relationships.

Communication Difficulties

Communication is a multimodal process which includes both verbal and non-verbal components. Contextual information can lead to better understanding of what is said (visual contact, facial expression, gesture, body posture and movement, paralinguistic features such as intonation). Insofar as interactions in distance learning are essentially textual, it is more difficult for the message sender to type it than to say it, and for the receiver, the verbal message is processed more slowly when it is read than when it is spoken (Walther, 1996). Moreover, the sender and the receiver do not have visual and non-verbal clues such as facial expression, intonation, posture, gesture, etc. (Olson and Olson, 1999). The verbal substitutes which aim to replace these clues in electronic communication (e.g. use of complex syntax or “smileys” replacing facial expression in a text message) require considerable effort and are often considered as being of poor quality and taking too long to substitute for non-verbal and para-verbal clues (McGrath and Hollingshead, 1994; Walther and D’Addario, 2001). Consequently, it is relatively common for messages to be misinterpreted (Cramton, 2001).

Clark and Brennan (1991) identified six characteristics distinguishing face-to-face from computer-mediated interactions:

- Co-presence: the group members are in the same place
- Visibility: group members can see each other
- Audibility: group members can hear each other
- Co-temporality: the message is received at approximately the same time as it is sent
- Simultaneity: Members of the group can send and receive messages simultaneously
- Sequentiality: group members express themselves in turn

Thus, during chat-room interactions, participants can send text messages in real time, the communication is co-temporal, simultaneous, and sequential, but the group members cannot see each other, nor hear intonation patterns, unless the session is combined with a video- or audio-conference.

The use of “richer” technologies such as online audio-conferencing which uses the voice is supposed to restore para-verbal clues. The audio-conference seems to be an improvement on simple text communications (Whittaker and O’Conaill, 1997), while the added value of videoconferencing compared to audio-conferencing is much less clear (Rudman, Hertz, Marshall, and Dykstra-Erickson, 1997). However, team members who use audio-conferencing experience difficulties in interpreting silence and in speaking in turn on account of the lack of visual clues (Olson and Olson, 1999). Using the telephone instead of asynchronous communication can increase the social presence between two people, but this deteriorates rapidly when more than two people join in the conversation (Finholt, Sproull and

Kiesler, 2002). Extensive use of online videoconference does not help resolve the difficulties of collaborative distance learning. More worryingly, video associated with audio-conferencing provides no additional advantage to audio-conferencing used alone for small, well-established teams (Olson and Olson, 1999). Likewise, a problem between people who meet infrequently is not solved simply by activating a videoconference. In recently constituted teams, the participants form less favourable impressions of each other than when they have face-to-face interactions (Storck and Sproull, 1995). This outcome has led a number of researchers to comment that videoconferencing is effective, but only when it involves people who know each other well (Nardi and Whittaker, 2002). Videoconferencing can thus be useful to maintain the relationship of established teams whose members know each other well and/or have already worked together.

Distance has also been acknowledged as an important factor in reducing the frequency of interactions, not only between potential partners, but also between people who already work together (Kraut, Fussell, Brennan, and Siegel, 2002). It has been suggested that the frequency of communications decreases as the distance increases, reaching its asymptote at about 30 meters (Olson, Teasley, Covi, and Olson, 2002), thereby justifying the well-known saying “out of sight, out of mind” (Armstrong and Cole, 1995; Michinov, 2008). Other researchers have commented on the fact that virtual teams have the appropriate tools for carrying out projects, writing joint documents, or holding distance meetings, but that there is still no technology for interacting with a colleague round a coffee machine (Fish, Kraut, and Chalfonte, 1990). Perhaps things are changing today with the development of virtual reality immersion environments?

The Lack of Mutual Awareness

The awareness of a shared situation (Salas, Burke, and Samman, 2001), mutual knowledge (Cramton, 2001), or common ground (Clark and Brennan, 1991), which allows group members to build and maintain a shared view of a problem, is crucial for group functioning. This mutual awareness is inevitably more difficult to attain when working at a distance. It emerges when team members not only have the same information but are also aware that they share it. It can emerge directly when the information is available through an initial experience with an individual or based on social interactions (Krauss and Fussell, 1990). The absence of mutual knowledge in virtual groups leads to greater confusion and inaccuracies in decision-making (Thompson and Coovert, 2003). According to Cramton (2001), one of the main reasons for communication becoming more difficult is that greater efforts have to be made to express the nuances of what one wants to say without the use of paralinguistic clues (see also Delfino and Manca, 2007). For example, one way of checking whether a message has been understood is to observe the listener’s signs of approval. These are often verbal, but can also be non-verbal (nodding the head, a smile, signs of attention). In electronic communication, these signs are almost impossible, and group members must try and get feedback from the other members while carrying out a task. This feedback ensures that the person’s perceptions of the task are well-founded, although it is often not easy to obtain.

Failure to Develop Interpersonal Relationships

Cohesion, confidence and interpersonal relationships are important determining factors for team efficiency. For Kiesler and Cummings (2002), the efficiency of virtual teams lies in the coordination of individual efforts and in group cohesion. By reducing the salience of situational variables, members of virtual teams can become victims of the fundamental error of attribution (Ross, 1977). For example, if a person fails to reply to an email, the sender will readily attribute an explanation relating to the person (“this person is lazy”, “she’s big-headed”) rather than to the situation (“this person is away”, “he’s got a problem with the server”, etc.). These errors of attribution can affect a subsequent sense of satisfaction and willingness to cooperate. In some cases, as in online communities, they can often lead to members dropping out.

Practical Recommendations

The following are some of the strategies identified by Thompson and Coovert (2006) which can be used to improve the functioning and support of virtual groups:

- 1) Give more time
- 2) Organize face-to-face meetings
- 3) Use synchronous communication
- 4) Train the group members
- 5) Develop efficient leadership

1- Give More Time

The most useful technique for supporting and facilitating virtual group work is to give enough time. According to certain estimations, it takes 4 to 5 times longer for virtual groups to carry out a joint task than face-to-face groups, without providing any extra advantage (Dubrovsky et al., 1991; Walther, 1996; Weisband, 1992). It appears that not only do people type more slowly than they speak, but they also take longer to adapt to the medium with which they will have to collaborate textually or in another way. Virtual groups with short deadlines are particularly vulnerable to the negative effects of the novelty of the medium used and pressure of time. While the effects of electronic communications on discussion time are widely known, the impact of time pressure and media novelty have been much less investigated. Virtual groups with plenty of time tend to focus their efforts on adjusting to the media (Walther, 1992). Electronic discussions become more interpersonal as the group members become familiar with the medium (Lebie, Rhoades, and McGrath, 1996). Pressure of time can prevent virtual groups from organizing themselves at the moment. In addition to managing the novelty of the medium, insufficient time can also have a negative effect on the collaboration by dispensing with the affective discussions about the content, which can lead to tense relationships, frustration and poor performance (Walther, 2002). The literature suggests that most of the negative effects of CMC, which are partially due to pressure of time and inexperience, diminish with time. The performance of groups which use CMC improves

with time to reach a comparable level to those of face-to-face groups (Hollingshead, McGrath, and O'Connor, 1993). Examining the development of virtual groups over a period of 13 weeks, Arrow (1977) found patterns of results in line with the robust equilibrium model: social dynamics fluctuate during the first periods, followed by stability. Other patterns of results have recently been found for the development of virtual groups over time (Michinov and Michinov, 2007; Yoon and Johnson, 2008).

2- Organize Face-to-Face Meetings

Research has shown that when individuals meet face to face, they subsequently cooperate better when communicating via email (Armstrong and Cole, 2002). This first contact allows the objectives of the collaboration to be defined, while encouraging informal contacts which facilitate mutual understanding and confidence between the participants and consequently the integration of group members (Cramton, 2001). A shared social identity will in turn help the individuals to focus on shared values and increase their level of awareness about the viewpoints of their partners, their communication styles, and their skills in a particular area. Conversely, other studies carried out in the field of distance learning have shown that bringing people together at the beginning of an online collaborative task does not necessarily lead to beneficial effects. Some researchers have even suggested that an initial face-to-face meeting acts as a powerful brake to future participation and group cohesion (Salmon, 2000). Further research is thus necessary to investigate whether face-to-face meetings during an online collaborative task facilitate the social integration of the learners and improve the task commitment and group cohesion. In this context, theoretical models of group development can help identify when a face-to-face contact is needed in an online collaborative task (e.g., Tuckman, 1967; Gersick, 1988; Wheelan, 1994). In order to identify virtual group development, a study was carried out with adults on a distance learning course (Michinov and Michinov, 2007). It aimed to study the development of a virtual learning group over a period of several weeks. Observations showed the existence of a transition period half way through an online collaborative activity. This period corresponds to the one identified by Gersick (1988) in traditional groups when there is a deadline for the collective project. In the context of an online collaborative task, it is characterized by an increased number of messages on the forum, particularly those of a socio-emotional nature, a loss of motivation and a desire to drop out, a need for more face-to-face contact linked to a more marked use of synchronous communication tools (chat-rooms and telephone), increased references to time and a lowering of the participants' mood. In a second study (Michinov and Michinov, 2008), a period of face-to-face contacts was organized at the mid-point of the online work in order to reduce the negative consequences observed in the previous study, and notably the need for face-to-face contact felt by the learners as well as the desire to drop out. In effect, by meeting the need for contact and reducing the desire to drop out observed half way through an online collaborative task, this contact should stimulate participation and task commitment and thus be particularly beneficial. This hypothesis was confirmed by the findings which showed that face-to-face contact half way through the task had a positive impact on participation. However, analysis of the results on a time dimension revealed the emergence of a new transition period between this mid-term contact and the end of the collaborative activity. This transition was characterized by reduced participation and task-related interaction. At the same time, an

increase in the interactions focusing on coordination and social relationships was observed, together with greater need for face-to-face contact, stronger desire to drop out and more use of synchronous communication tools. These results suggest that organizing a meeting at the mid-point of the online collaborative activity has an overall positive impact on the level of participation, but that a new transition period emerges half way through the second part of the task, i.e. after the mid-point meeting. Understanding how groups develop in computer-mediated communication environments should help support the group and organize meetings at the opportune moment.

3- Use Synchronous Communications

Chat-rooms allow discussions with everyone, while instant messaging (IM) allows interactions in pairs. These two technologies differ from email in that it is not necessary to answer and that the interactions are often informal, brief and relatively close to those which take place face to face (Kraut et al., 2002). However, users see IM as being less intrusive than the telephone and more spontaneous than email (Nardi and Whittaker, 2002). People who use IM experience a strong sense of belonging to a collective and develop positive feelings, having the possibility of identifying people around them, even if direct face-to-face communication is impossible.

Research has shown that organizing chat-room discussions could be an alternative for groups with insufficient resources (time, money, etc.), enabling them to establish occasional brief virtual interactions. For example, Zheng, Veinott, Bos, Olson, and Olson (2002) found that people who do not meet face to face but who get to know each other in chat-room discussions before carrying out a group task express a higher level of confidence than the others. Likewise, using a chat-room to get to know one another is almost as efficient as a face-to-face meeting (Zheng et al., 2002). Setting up “virtual meetings” while carrying out a collaborative task limits the deterioration of interactions and optimizes group functioning (Nardi and Whittaker, 2002). Insofar as webcam discussions are often perceived as being relatively intrusive, virtual groups must be able to set up tools which increase the feeling of social presence and shared awareness by initiating discussions in real time by chat-room discussions or instant messaging (Walther, 2002). These technologies can be used to exchange brief questions and answers and negotiate the time allotted to online discussions and the way they are organized. The group members must also be able to use traditional media like the telephone as soon as they feel the need. By establishing relationships with the help of these technologies, individuals create a virtual work environment similar to the open spaces where interactions can occur at any moment between people in the near physical environment (Heerwagen, Kampschroer, Powell, and Loftness, 2004). At the theoretical level, two forms of distant presence need to be distinguished: physical and social. *Physical presence* relates to the feeling of being together in the same place (*physical togetherness*), while *social presence* refers to the feeling of belonging to the same group of people (*we-ness*). These two forms of presence do not have the same roots and work relatively independently (Michinov, 2008). For example, a technology can provide a high degree of physical presence due to immersion in a virtual environment without the individuals being able to send each other reciprocal communication signals. Conversely, a certain social presence can be felt – an impression of belonging to a group – by using applications which give poor visual and

graphic clues (e.g. chat-room, discussion forum, instant messaging). From this observation, we can consider that sophisticated technologies are not required to give members of a virtual group a sense of belonging, but that simple text tools can suffice to develop a social presence at a distance.

4- Training Group Members

Particular attention needs to be paid to training people who are going to work and/or learn in virtual groups. This will involve training in both the use of the available technologies and in working together. It is essential for participants to be familiar with the technologies at their disposal. When members of a group are not aware of the potentials and functionalities of these technologies, they develop negative norms and perceptions of them. Training in the use of technologies must foster open discussion about the difficulties of electronic communications, and training courses must focus on the potential consequences of this type of communication and on strategies for overcoming any difficulties (Weisband, 2002). Members of virtual groups must learn to exchange contextual information such as the objectives to be reached, the progress achieved, their partners' contributions. They must also be made aware of the difficulties of maintaining cohesion and a sense of belonging at a distance. Support strategies must be set up with this in mind, knowing that it is often difficult, if not impossible, to bring all the team members together round a table. Likewise, it is particularly important that the group members have a relatively precise idea of the knowledge and skills of each other. In computer-mediated communication environments, it is not enough just to have a "who's who" type directory to look up addresses and contact details, but group members must also develop a "transactive memory system" (e.g. Wegner, 1986). This system consists of a shared knowledge of "who knows what in the group". The development of this system is based on communication processes which allow each member of the group to encode, store and retrieve the knowledge relevant to carrying out a common task, thanks to a more detailed knowledge of what their partners know and do not know (e.g., Liang, Moreland, and Argote, 1995; Michinov and Michinov, 2009). Insofar as the transactive memory system is based on communication processes, its construction should be affected by the nature of the medium used (synchronous or asynchronous textual communication systems, video- or audio-conferencing, etc.).

5- Develop Efficient Leadership

The managers – or leaders – of virtual groups can play a central role in implementing the above strategies by acting as group process facilitators. It has been shown that online groups with a facilitator whose job is to see that a project is carried out in the allotted time achieve better performances than groups without one (e.g., Weisband, 2002). By contrast, group members who do not have the status of leader are not in a position to improve group performance when they put pressure on the others. However, there has been little research into the effect of introducing a facilitator who has the role of optimizing the organization and functioning of virtual groups. Research in this area has mainly investigated the effects of leadership style on the performance of groups whose members collaborate synchronously

using different types of media – face-to-face, chat-rooms or video-conference (e.g., Hambley, O’Neill, and Kline, 2007; Hoyt and Blascovitch, 2003; Sosik, Avolio, Kahai, and Jung, 1998). In these studies, the leader, generally an assistant of the experimenter, is instructed to give group members information in a predetermined style, either transactional or transformational. By definition, the transactional style is based on coercion, whereby the leader uses rewards and punishments to motivate the group members; he/she is interventionist and insists on the individual commitment of each member in carrying out the task. By contrast, the transformational style is based on encouragement in which the leader helps the group members to reach an objective, to look at an idea or opinion in more depth so that they progress together; he gives direction and insists on collective commitment in carrying out the task (Bass, 1985; 1990). These leadership styles sometimes produce different effects depending on the medium used (e.g. Sosik et al., 1998), sometimes no effect (e.g., Hambley et al., 2007). As a general rule, transformational leadership gives better results than a transactional style. However, in these experiments, the facilitator is never called on to set up a framework or structure to optimize the group members’ performance, learning and satisfaction. It seems, however, that providing groups with a framework is much more important in online groups than in groups located in the same place (e.g., Mannix, Neale, and Tenbrunsel, 2006).

In the context of virtual groups, leaders can visit distant co-team members in person, talk to them about the problems they may be experiencing, and give them time to talk about any difficulties they have encountered. When this strategy is difficult to implement, virtual groups can also benefit from a leader who encourages frequent and structured interactions (Armstrong and Cole, 2002). However, research into virtual groups of learners who use discussion forums suggests that if the facilitator (tutor) plays too strong a role, participation decreases, even if at the same time he/she is judged to be more competent and expert than a facilitator who gives few messages (Mazzolini and Maddison, 2003).

CONCLUSION

Practices which involve working and learning together while being physically distant are becoming increasingly popular due to the many possibilities provided by communication technologies. Years of research showed the challenges which confronted traditional groups or teams, but which seem to be slight compared to those facing virtual groups and teams (Thompson and Coovert, 2006). While a number of strategies can be recommended, most of these are still at the idea stage and require in-depth studies and planned experiments to prove their effectiveness. Nevertheless, we have attempted to identify the advantages and pitfalls of the new forms of social interaction which have been made possible by technological advances, and have made a number of recommendations with the aim of optimizing the functioning of virtual groups by looking at them as socio-technical systems devoted to collaborative work and learning. Even if the data gathered so far does not provide us with a very clear picture of the specificity of these interactions, it is evident that this is a more and more widespread form of communication which affects all sectors of social and economic life in the digital age.

REFERENCES

- Armstrong, D., and Cole, P. (1995). Managing distance and differences in geographically distributed work groups. In S. E. Jackson and M. N. Ruderman (Eds.), *Diversity in work teams*. Washington, DC: APA.
- Arrow, H. (1997). Stability, bistability, and instability in small group influence patterns. *Journal of Personality and Social Psychology*, *72*, 75-85.
- Bass, B.M. (1985). Leadership: Good, better, best. *Organizational Dynamics*, *13*, 26-40.
- Bass, B. M. (1990). From transactional to transformational leadership: Learning to share the vision. *Organizational Dynamics*, *18*, 19-31.
- Bordia, P. (1997). Face-to-face versus computer-mediated communication: A synthesis of the experimental literature. *Journal of Business Communication*, *34* (1), 99-120.
- Clark, H. H., and Brennan, S. E. (1991). Grounding in communication. In L. B. Resnick, J. M. Levine, and S. D. Teasley (Eds.), *Perspectives on socially shared cognition* (pp. 127-149). Washington, DC: APA.
- Cramton, C. (2001). The mutual knowledge problem and its consequences in dispersed collaboration. *Organization Science*, *12*, 346-371.
- Delfino, M., and Manca, S. (2007). The expression of social presence through the use of figurative language in a web-based learning environment. *Computers in Human Behavior*, *23*, 2190-2211.
- Dubrovsky, V. J., Kiesler, S., Stehna, B. N. (1991). The equalization phenomenon: Status effects in computer-mediated and face-to-face decision making groups. *Human-Computer Interaction*, *6*, 119-146.
- Fish, R.S, Kraut, R.E., and Chalfonte, B.L. (1990). The VideoWindow system in informal communications. In F. Halasz (Ed.), *Proceedings of the Conference on Computer-Supported Cooperative Work (CSCW'90)* (pp. 1-11), New York: ACM Press.
- Finholt, T., Sproull, L., and Kiesler, S., (2002). Outsiders on the inside: Sharing know-how across space and time. In P. Hinds and S. Kiesler, *Distributed work* (pp. 357-380). Cambridge, MA: MIT press.
- Gersick, C. (1988). Time and transition in work teams: Toward a new model of group development. *Academy of Management Journal*, *31*, 9-41.
- Hambley, L. A., O'Neill, T. A., and Kline, T. J. B. (2007). Virtual team leadership: The effects of leadership style and communication medium on team interaction styles and outcomes. *Organizational Behavior and Human Decision Processes*, *103*, 1-20.
- Heerwagen, J.H., Kampschroer, K., Powell, K.M., and Loftness, V. (2004). Collaborative knowledge work environments. *Building Research and Information*, *32* (6), 510-528.
- Hollingshead, A. B., McGrath, J. E., and O'Connor, K. M. (1993). Group task performance and communication technology: A longitudinal study of computer-mediated versus face-to-face groups. *Small Group Research*, *24*, 307-333.
- Hoyt, C. L., and Blascovich, J. (2003). Transformational and transactional leadership in virtual and physical environments. *Small Group Research*, *34*, 678-715.
- Kiesler, S., and Cummings, J. N. (2002). What do we know about proximity in work groups? A legacy of research on physical distance. In P. Hinds and S. Kiesler (Eds.) *Distributed Work* (pp. 57-80). Cambridge: MIT press.

- Krauss, R., and Fussell, S. (1990). Mutual knowledge and communicative effectiveness. In J. Galegher, R.E. Kraut, and C. Egido (Eds), *Intellectual Teamwork: The Social and Technological Bases of Cooperative Work* (pp.111-44). Hillsdale, NJ: Erlbaum.
- Kraut, R. E., Fussell, S. R., Brennan, S., and Siegel, J. (2002). Understanding effects of proximity on collaboration: Implications for technologies to support remote collaborative work. In P. Hinds and S. Kiesler (Eds.), *Technology and Distributed Work* (pp.137-162). Cambridge, MA: MIT Press.
- Lea, M., Rogers, P., and Postmes, T. (2002). SIDE-VIEW: Evaluation of a system to develop team players and improve productivity in Internet collaborative learning groups. *British Journal of Educational Technology*, 33, 54-64.
- Lea, M., Spears, R., and de Groot, D. (2001). Knowing me, knowing you: Anonymity effects on social identity processes within groups . *Personality and Social Psychology Bulletin*, 27, 526–537.
- Lebie, L., Rhoades, J.A., and McGrath, J.E. (1996). Interaction process in computer-mediated and face-to-face groups. *Computer Supported Cooperative Work*, 4, 127-152.
- Liang, D. W., Moreland, R., and Argote, L. (1995). Group versus individual training and group performance: The mediating role of transactive memory. *Personality and Social Psychology Bulletin*, 21(4), 384-393.
- Mannix, E., Neale, M., and Tenbrunsel, A. (Eds.). (2006). *Research on Managing Groups and Teams: Ethics in Groups*, vol 8. Oxford, UK: Elsevier Science Press.
- Mazzolini, M., and Maddison, S. (2003). Sage, guide or ghost? The effect of instructor intervention on student participation in online discussion forums. *Computers and Education*, 40(3), 237-253.
- McDaniel, S., Olson, G., and Magee, J. (1996). Identifying and analyzing multiple threads in computer-mediated and face-to-face conversations, In *Proceedings of the Conference on Computer Supported Cooperative Work*, ACM Press, Cambridge, MA, pp. 39-47.
- McGrath, J. E. and Hollingshead, A. B. (1994). *Groups interacting with technology*. Newbury Park, CA: Sage.
- Michinov, E. (2008). La distance physique et ses effets dans les équipes de travail distribuées: Une analyse psychosociale. *Le Travail Humain*, 1, 1-21.
- Michinov, E., and Michinov, N. (2007). Identifying a transition period at the midpoint of an online collaborative activity: A study among adult learners. *Computers in Human Behavior*, 23, 1355-1371.
- Michinov, E., and Monteil, J.M. (2003). Attraction personnelle et attraction sociale : Lorsque la saillance catégorielle annule la relation similitude-attraction. *Canadian Journal of Behavioural Science*, 35, 305-315.
- Michinov, N., Michinov, E., and Toczec-Capelle, M.-C. (2004). Social identity, group processes and performance in synchronous computer-mediated communication. *Group Dynamics. Theory, Research, and Practice*, 8 (1), 27-39.
- Michinov, N., and Michinov, E. (2008). Face-to-face contact at the midpoint of an online collaboration: Its impact on the patterns of participation, interaction, affect, and behavior over time. *Computers and Education*, 50, 1540-1557.
- Michinov, N., and Michinov, E. (2009). Investigating the relationship between transactive memory and performance in collaborative learning. *Learning and Instruction*, 19, 43-54.

- Nardi, B., and Whittaker, S. (2002). The place of face-to-face communication in distributed work. In P. Hinds and S. Kiesler, *Distributed work* (pp. 83-110). Cambridge, MA: MIT press.
- Olson, J. S., and Olson, G. M. (1999). Computer supported cooperative work. In F.T. Durso, R.S. Nickerson,, R.W. Schvaneveldt, S.T. Dumais, , D.S. Lindsay, and M.T.H. Chi (Eds.), *Handbook of applied cognition* (pp. 409-442). New York: Wiley.
- Olson, J. S., Teasley, S., Covi, L., and Olson, G. M. (2002). The (currently) unique advantages of collocated work. In P. Hinds, and S. Kiesler (Eds.), *Distributed Work* (pp. 113-136). Cambridge, MA: MIT Press.
- Postmes, T., Spears, R., and Lea, M. (1998). Breaching or building social boundaries? SIDE-effects of computer-mediated communication. *Communication Research*, 25, 689–715.
- Reicher, S. D., Spears, R., and Postmes, T. (1995). A social identity model of deindividuation phenomena. In W. Stroebe and M. Hewstone (Eds.), *European Review of Social Psychology* (Vol. 6, pp. 161–198). Chichester, UK: Wiley.
- Rogelberg, S. G., Leach, D.J., Warr, P.B., and Burnfield, J.L. (2006). “Not another meeting!” Are meeting time demands related to employee well-being? *Journal of Applied Psychology*, 1, 86-96.
- Ross, L. (1977). The intuitive psychologist and his shortcomings: Distortions in the attribution process. In L. Berkowitz (Ed.), *Advances in experimental social psychology* (pp. 173–220). New York: Academic Press.
- Rudman, C., Hertz, R., Marshall, C., and Dykstra-Erickson, E. (1997). Channel overload as a driver for adoption of desktop video for distributed work. In K.E. Finn, A.J. Sellen, and S.B. Wilbur, (Eds.), *Video-Mediated Communication* (pp. 61-70). Mahwah, NJ: LEA.
- Salas, E., Burke, C.S., and Samman, S.M. (2001). Understanding command and control teams operating in complex environments. *Information, Knowledge, Systems Management*, 2, 311-323.
- Salmon, G. (2000). *E-moderating. The key to teaching and learning online*. London: Kogan Page.
- Sosik, J. J., Avolio, B. J., Kahai, S. S., and Jung, D. I. (1998). Computer-supported work group potency and effectiveness: The role of transformational leadership, anonymity, and task interdependence. *Computers in Human behavior*, 14, 491-511.
- Spears, R., and Lea, M. (1992). Social influence and the influence of the ‘social’ in computer-mediated communication. In M. Lea (Ed.), *Contexts of computer-mediated communication* (pp. 30–65). New York: Harvester Wheatsheaf.
- Spears, R., and Lea, M. (1994). Panacea or panopticum? The hidden power of computer mediated communication. *Communication Research*, 21, 427–459.
- Storck, J., and Sproull, L. (1995). Through a glass darkly – what people learn in videoconferences? *Human Communication Research*, 22, 197-219.
- Straus, S.G., and McGrath, J.E. (1994). Does the medium matter? The interaction of task type and technology on group performance and member actions. *Journal of Applied Psychology* 79, 87-97.
- Thompson, L. F., and Coovert, M. D. (2003). Teamwork online: The effects of computer conferencing on perceived confusion, satisfaction, and post-discussion accuracy. *Group Dynamics: Theory, Research, and Practice*, 7 (3), 135-151.

- Thompson, L. F., and Coover, M. D. (2006). Understanding and developing virtual CSCW teams. In C. A. Bowers and E. Salas (Eds.), *High-Tech Teams: Making Effective Work Teams with People, Machines, and Networks*. Washington, DC: APA.
- Tuckman, B. W. (1965). Developmental sequence in small groups. *Psychological Bulletin*, *63*, 384-399.
- Walther, J. B. (1992). Interpersonal effects in computer-mediated interaction: A relational perspective. *Communication Research*, *19*, 52-90.
- Walther, J. B. (1996). Computer-mediated communication: Impersonal, interpersonal, and hyperpersonal interaction. *Communication Research*, *23* (1), 3-43.
- Walther, J. B. (2002). Time effects in computer-mediated groups: Past, present, and future. In P. Hinds and S. Kiesler (Eds.), *Distributed work* (pp. 235-257). Cambridge, MA: MIT Press.
- Walther, J. B., and D'Addario, K. P. (2001). The impacts of emoticons on message interpretation in computer-mediated communication. *Social Science Computer Review*, *19*, 323-345.
- Wegner, D. M. (1986). Transactive memory: A contemporary analysis of the group mind. In B. Mullen and G. R. Goethals (Eds.), *Theories of group behavior* (pp. 185-208). New York: Springer.
- Weisband, S. P. (1992). Group discussion and first advocacy effects in computer-mediated and face-to-face decision making groups. *Organizational Behavior and Human Decision Processes*, *53*, 352-380.
- Weisband, S. (2002). Maintaining awareness in distributed team collaboration: Implications for leadership and performance. In P. Hinds and S. Kiesler (Eds.), *Distributed work* (pp. 311-333). Cambridge, MA: MIT Press.
- Wheelan, S. A. (1994). *Group processes: A developmental perspective*. Sidney: Allyn and Bacon.
- Whittaker, S., and O'Conaill, B. (1997). The role of vision in face-to-face and mediated communication. In K. E. Finn, A. J. Sellen, and S. B. Wilbur (Eds.) *Video-mediated communication* (pp. 23-49). Mahwah, NJ: LEA.
- Yoon, S.W., and Johnson, S.D. (2008). Phases and patterns of group development in virtual learning teams. *Educational Technology Research and Development*, *56* (5-6), 595-618.
- Zheng, J., Veinott, E., Bos, N.D., Olson, J.S., and Olson, G.M. (2002). Trust without touch: Jumpstarting long-distance trust with initial social activities. In *Proceedings of CHI 2002*. New York: ACM Press.

Chapter 5

TEMPERAMENT, SHYNESS, AND ANXIETY DISORDERS: LOOKING FOR LINKS ACROSS THE LIFESPAN

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ABSTRACT

Temperamental shyness is an early appearing, extreme form of shyness that is observed in approximately 5-10% of typically developing children. This form of shyness is associated with a pattern of heightened fearfulness and behavioral restraint in the face of both social and non-social forms of novelty and serves as a risk factor for the development of anxiety disorders later in life. Here we provide a brief overview of this temperamental style, with a special focus on its biological underpinnings and its expression across the lifespan. Our findings suggest that temperamentally shy individuals exhibit a distinct pattern of central and autonomic physiology that is associated with hypersensitive forebrain-limbic circuits. These differences in neurophysiology emerge during early post-natal life, are evident during resting conditions and in response to various social stressors, and appear to remain modestly stable throughout development, possibly pre-disposing individuals for further psychopathology. We also discuss the importance of dynamic interactions between genes and environments (both exogenous and endogenous) in the development of socio-affective systems and the utility of psychophysiological measures in helping us to bridge the gap among genes, brains and behaviors.

INTRODUCTION

Newborns present with individual differences in their ability to regulate emotion as well as variability in the style, intensity, and extent to which they react to environmental stimuli at birth and thereafter. These individual differences in regulation and reactivity are known as

temperament (Rothbart, 1981). Temperament remains relatively stable during development (Kagan 1994, 1999), and some temperaments are known to predict risk for anxiety and other psychopathologies (Biederman, Hirshfeld-Becker, Rosenbaum, Perenick, Wood and Faraone, 2001; Hayward, Killen, Kraemer, Taylor, 1998; Hirshfeld et al., 1992; Hirshfeld-Becker et al., 2007; Lahey, 2004; Rosenbaum, Biederman, Bolduc-Murphy, and Faraone, 1993; Schwartz, Snidman, and Kagan, 1999).

Shyness is one temperament that is perhaps best conceptualized as an early appearing risk factor for the later emergence of mood and anxiety disorders (Biederman et al., 2001; Hayward et al., 1998; Hirshfeld et al., 1992; Hirshfeld-Becker et al., 2007; Rosenbaum et al., 1993; Schwartz et al., 1999). Many of the cognitive (e.g., biased processing of social threat) and psychophysiological (e.g., asymmetries in frontal brain electrical activity) features that typify temperamental shyness are shared with anxiety disorders in general, and social anxiety in particular. Similarities between shyness and social anxiety are likely explained by common cognitive and neural mechanisms (see Pérez-Edgar and Fox, 2005, for a review).

The purpose of the present chapter was to review recent evidence on temperamental shyness and its relation to anxiety-related problems. The chapter is divided among four main sections. Section one is devoted to a description of the phenomenon of temperamental shyness, including its definition, origins, and correlates. The second section comprises work from recent and ongoing studies from our laboratory examining the psychology, physiology, and genetics of temperamental shyness and the search for developmental links to anxiety. In section three, we present an overview of hypothesized multiple determinants of temperamental shyness. The final section presents a discussion of the theoretical and practical implications of studying temperamental shyness.

TEMPERAMENTAL SHYNESS

What is it?

Temperamental shyness refers to an early appearing and extreme form of shyness which is observed in approximately 5-10% of typically developing children (García Coll, Kagan, and Reznick, 1984; Kagan, Reznick, and Snidman, 1987, 1988). This form of shyness is associated with a pattern of fearfulness and behavioral restraint in the face of both social and non-social forms of novelty (see Kagan, 1994, 1999, for reviews). Early physiological and behavioral markers of temperamental shyness emerge within the first four months of post-natal life (Kagan and Snidman, 1991). Infant predictors of temperamental shyness include patterns of high motor activity (e.g., limb trashing, spastic back arching) and emotional distress (e.g., crying, fussing) in response to the presentation of novel visual, auditory, and olfactory stimuli. Moreover, a subset of the highly motoric and easily aroused infants also exhibit elevated fetal heart rates and elevated heart rates during sleep, when held erect, within the first two weeks following birth (Kagan, 1994) and are at risk for the later development of anxiety disorders (Biederman et al., 2001; Hirshfeld et al., 1992; Schwartz et al., 1999).

What are its Origins?

One hypothesis is that the origins of temperamental shyness result from a sensitization of key forebrain-limbic structures that mediate aspects of emotional expression, experience and regulation (Kagan, 1994). Specifically, the hyper-excitability of the central nucleus of the amygdala [the main output area of the amygdala, with associated projections to the hypothalamic-pituitary-adrenal (HPA) system and brainstem nuclei involved in behavioral freezing and autonomic arousal] has been implicated as a diathesis factor in the development of behavioral inhibition (Kagan, 1994; Schmidt and Fox, 1999). Tonic differences in the excitability of the amygdala (and central nucleus) may represent the proximal neurobiological mechanism that programs the reactivity thresholds of stress reactive systems. This hypothesis is supported by several lines of evidence stemming from comparative studies, including the finding of heightened amygdala activation in defensive compared to non-defensive cats (Adamec, 1991), and the facilitation of fearful responses in rats induced by electrical kindling of the central nucleus (Rosen, Hamerman, Sitcoske, Glowa, and Schulkin, 1996).

What are its Correlates?

Temperamental shyness has multiple correlates, including behavioral, cognitive/affective, and biological. The behavioral correlates of temperamental shyness vary as a function of the age-reference being examined. Fear of novelty at 9 months of age can be evoked in response to stranger approach, whereas at 2 years of age and into the pre-school and early school age years, the relevant behavioral correlates include a reluctance to vocalize, close proximity to the caregiver during free play interactions, a long latency to approach novel objects, and an increased likelihood of social withdrawal (Calkins, Fox, and Marshall, 1996; Kagan et al., 1987, 1988). Other behavioral manifestations of shyness include gaze aversion and self-manipulative actions during social interactions (Pilkonis, 1977). Despite variability in the behavioral expression of shyness across development, the underlying mechanisms sustaining the phenomenon are presumed to remain stable over time (Fox, Henderson, Rubin, Calkins, and Schmidt, 2001).

Temperamental shyness is also associated with a cognitive style that involves a pre-occupation with the self in real or imagined social situations (Cheek and Melchoir, 1990), negative evaluations of self-worth (Crozier, 1981) and with the experience and expression of negative affect (Kagan et al., 1987, 1988). Shyness can be conceptualized as biasing information processing systems, such that social situations that might be perceived as innocuous by non-shy individuals are interpreted by shy individuals as being replete with danger and therefore highly threatening (Schmidt and Schulkin, 1999). This cognitive/affective profile has adverse consequences for the development of successful social engagement processes and may further exacerbate the social isolation and loneliness that is experienced by shy individuals.

Temperamental shyness is also linked to a distinct pattern of biological responses across a range of systems that are connected, either directly or indirectly, with forebrain limbic areas such as the amygdala and frontal cortex. For example, temperamentally shy children show elevated levels of basal cortisol (Kagan et al., 1987, 1988; Schmidt, Fox, Rubin, Sternberg, Gold, and Smith, 1997), a high and stable (i.e., minimally variable) resting heart rate (Kagan

et al., 1987, 1988), and heightened baseline startle responses (Schmidt and Fox, 1998; Snidman and Kagan, 1994). In addition, temperamentally shy individuals exhibit a pattern of greater relative resting right frontal EEG activity (Fox et al., 2001; Fox, et al., 1995). A more complete discussion of the biological correlates of temperamental shyness is presented later in this chapter.

CURRENT AND ONGOING STUDIES: LOOKING FOR LINKS ACROSS THE LIFESPAN

A study of the broad-based biological correlates of temperamental shyness has been the specific focus of our research program. We have utilized a multi-method approach that includes measures of regional brain electrical activity (e.g., EEG, ERP), peripheral physiology (e.g., heart rate, heart rate variability, cardiac vagal tone) and neuroendocrine function (e.g., salivary cortisol). More recently, we have employed molecular genetic and functional neuroimaging (fMRI) indices. Our paradigm has centered on examining the baseline and stress reactive psychophysiological profile of temperamentally shy individuals, particularly the developmental course of this profile from infancy into adulthood.

Studies of Typically Developing Infants

We have previously reported that infants selected for constellations of temperamental shyness (high motor activity/high negative affect) at 4 months of age exhibit greater relative right frontal EEG activity at 9 and 24 months when compared with other groups of infants (high motor activity/low negative affect, low motor activity/low affect) (Calkins et al., 1996; Fox, Calkins, and Bell, 1994). Greater relative right frontal EEG activity at baseline may reflect deficient regulation of limbic arousal associated with negative affect (Davidson and Irwin, 1999; Fox, 1991; Schmidt and Fox, 1999). Interestingly, a consistent pattern of greater right frontal EEG asymmetry at 9 and 14 months of age is predictive of stability in temperamental shyness across the first 4 years of life (Fox et al., 2001). Infants selected for temperamental shyness at 4 months of age also display greater fear-potentiated (stranger approach) eyeblink startle amplitudes at 9 months (Schmidt and Fox, 1998) compared to infants previously classified in the positive affect and low reactive groups. The startle response is a primitive defensive reflex that is modulated by an amygdala-based circuit (Lang, 1995).

Studies of Typically Developing Preschoolers/Early School Age Children

In studies of preschoolers, we have reported greater relative right anterior EEG activity (Fox et al., 1995, Fox, Schmidt, Calkins, Rubin, and Coplan, 1996; Theall-Honey and Schmidt, 2006) and increased salivary cortisol concentrations (Schmidt et al., 1997) at baseline among high shy children at 4 years of age. We have also found that temperamentally

shy children exhibit a distinct psychophysiological profile in response to social stress at 7 years of age (Schmidt, Fox, Schulkin, and Gold, 1999). Compared with their non-shy peers at age 7, temperamentally shy children exhibited a greater increase in right frontal EEG activity and a greater increase in heart rate during the performance of a self-presentation task. These data are generally consistent with other research, indicating high levels of basal adrenocortical activity, high and stable resting heart rates (indicative of low vagal tone) and exaggerated startle responses among inhibited children (Kagan et al., 1987, 1988; Snidman and Kagan, 1994). Interestingly, the high levels of basal and reactive cortisol observed among shy children may initiate a positive feedback pathway, by stimulating corticotropin-releasing hormone (CRH) gene expression in the central nucleus of the amygdala and thereby activating a perceptual framework for fear (Schmidt et al., 1997; Schulkin and Rosen, 1999). However, recent research from our group suggests that temperamental shyness may be insufficient in predicting high cortisol levels in this age group.

A recent study by Schmidt, Santesso, Schulkin, and Segalowitz (2007) revealed two distinct shy phenotypes in a group of 10-year old children: a high shy/high salivary cortisol group and a high shy/low salivary cortisol group. These divergent phenotypes may reflect multiple moderating influences such as parenting styles and emotional well-being. Clarifying the effects of various contextual influences on the expression of shyness should be one of the goals of future research as the distinct phenotypes may be characterized by differences in the level of risk for mood and anxiety disorders.

Studies of Healthy Adults

The biological correlates of temperamental shyness are largely preserved from infancy into adulthood. Adults scoring high on self-report measures of trait shyness (Cheek and Buss, 1981) exhibit a pattern of greater relative resting right frontal EEG activity (Schmidt, 1999). High shy adults also exhibit a higher and more stable heart rate in response to the anticipation of a novel social encounter (Schmidt and Fox, 1994). However, we have noted that the pattern of adrenocortical activity associated with temperamental shyness may change with development. Young adults who are high in self-reported shyness exhibit low baseline salivary cortisol in comparison with their non-shy counterparts (Beaton et al., 2006). Low salivary cortisol levels among shy adults may reflect an allostatic modulation of the HPA system in response to the repeated stressors and coping challenges that are faced by this population beginning early in life (Beaton et al., 2006). Similar findings of suppressed HPA function have been observed in social phobia and other stress related disorders, such as post-traumatic stress disorder (e.g., Fries, Hesse, Hellhammer, and Hellhammer, 2005). More recently, we have examined the neural correlates of affective information processing in shy and non-shy adults using event-related functional neuroimaging (fMRI; Beaton et al., 2008). Compared with their non-shy counterparts, shy adults display greater bilateral amygdalar activation in response to the presentation of unfamiliar neutral faces and greater left amygdala activation in response to the presentation of familiar neutral faces. This finding replicated previous research (Schwartz, Wright, Shin, Kagan, and Rauch, 2003), showing heightened amygdalar activation in response to novelty among adults who were originally classified as temperamentally shy children. Taken together, these data suggest that temperamentally shy

individuals exhibit a distinct pattern of central and autonomic physiology that is associated with hypersensitive forebrain-limbic circuits. These differences in neurophysiology emerge during the opening months of post-natal life, are evident during resting conditions and in response to various social stressors, and appear to remain modestly stable throughout development, possibly pre-disposing individuals for further psychopathology.

MULTIPLE DETERMINANTS

Etiological models of shyness differ in the extent to which they give precedence to biogenetic-dispositional (e.g., Kagan, 1994) or environmental-experiential (e.g., Stevenson-Hinde, 2000) considerations. Temperamental shyness is multiply-determined and hypotheses about its etiology need to model the multi-directional transactions that occur among biology, environment, and experience (see also, Schmidt, Miskovic, Boyle, and Saigal, 2008). Theories about the origin of shyness also need to remain sensitive to the contextual factors that influence the phenotypic expression of this trait.

A Role for Biology, Environment and Experience

The hereditary basis of inter-individual differences in temperament has long been affirmed by findings from inbred laboratory animal strains (e.g., Broadhurst, 1975) and from twin studies in behavioral genetics (e.g., Plomin, 1986). More recently, large gene-association studies have pointed to a molecular genetic basis for complex human traits (Schmidt and Fox, 2002). One of these associations has been between a functional repeated sequence polymorphism in the coding region of the gene for the dopamine D4 receptor (DRD4) and novelty seeking behavior. Adults with the long repeat sequence (6-8 repeats) self-reported higher novelty seeking (Benjamin et al, 1996; Ebstein et al., 1996) compared to those with the short variant (2-5 repeats) of the sequence. The long DRD4 repeat has also been linked to greater maternal report of aggression in children at 4 years of age (Schmidt, Fox, Rubin, Hu, Hamer, 2002) and problems with attention at 4 and 7 years of age (Schmidt, Fox, Pérez-Edgar, Hu, Hamer, 2001). The long repeat sequence variant codes for a receptor that is less efficient in binding the neurotransmitter dopamine compared to the short variant (Van Tol et al., 1992).

Another locus that has been of special interest to studies of individual differences in personality has been a functional polymorphism in the promoter region of a gene for the serotonin transporter (5-HTT). Transcription of the 5-HTT gene is modulated by short and long versions of the regulator region. The short allele leads to diminished transcription of 5-HTT and subsequently leads to reduced serotonin uptake and greater concentrations of serotonin within the synaptic cleft (Hariri et al., 2002). Adults with one or two copies of the short allele score higher on measures of anxiety, depression and neuroticism (Lesch et al., 1996) and show greater amygdalar activation to fear faces (Hariri et al., 2002) compared to those who are homozygous for the long allele. It is important to note that some studies, including one from our group (Schmidt et al., 2002), failed to find a link between the short

allele of the 5-HTT gene and negative emotionality (Deary et al., 1999; Kumakiri et al., 1999).

In addition to examining the main effects of specific genes on complex behaviors, it is worthwhile to consider the statistical interactions that occur between genes and environments as well as those within different sets of genes. Gene-environment interactions are likely to be especially important in shaping the trajectories of socio-affective and personality systems early in development. Fox and his colleagues (2005) reported that the presence of the short 5-HTT allele predicted behavioral inhibition and shyness in middle-childhood *only* in the presence of a specific environmental factor (maternal perceived social support). Children with one or two short alleles of the 5-HTT gene *and* whose mothers reported experiencing low levels of social support were more likely to be inhibited during same-sex peer interactions than any other genotype/environment group. In addition, these children were more likely to be reported as being shy by their mothers. This finding of a significant interaction is in contrast to a previous study from our group that failed to find a main effect for the short allele of the 5-HTT gene (Schmidt et al., 2002) and is also consistent with findings indicating that the short version of the 5-HTT promoter region interacts with life stress to confer a risk for psychopathology (Caspi et al., 2003; Kaufman et al., 2004). The most recent evidence from our group also highlights the need to consider the internal, organismic environment (*endoenvironment*) in putative Gene x Environment interactions (Schmidt, Fox, Perez-Edgar, and Hamer, in press).

Given that functional polymorphisms in the DRD4 and 5-HTT genes are independently associated with different trait-related constructs, the issue of cumulative biological risk emerges when considering gene-gene interactions. Schmidt and his colleagues (2007) found that the combination of the long DRD4 repeat *and* the short allele of the 5-HTT gene confers a risk for the expression of internalizing and externalizing problems in childhood that exceeds the risk associated with other combinations of these two gene variants. Future studies should focus on examining higher-level dynamics (e.g., gene-gene-environment) that approximate the sorts of interactive loops between biology and environment that guide development.

A final example of the multi-directional ways in which internal (nature) factors interface with experiential (nurture) factors is offered by a recent study of the selective face recognition deficits that are exhibited by shy children (Brunet, Mondloch, and Schmidt, submitted). In comparison to their non-shy counterparts, shy children display significant deficits when making same/different judgments about human faces that differ in the spacing of component features. Studies of infants with congenital cataracts have shown that sensitivity to the spacing of features (configural processing) depends on early experience with faces and requires visual input to the right hemisphere during specific periods of development (Le Grand, Mondloch, Maurer, and Brent, 2003). Children who are born with a biological predisposition toward temperamental shyness avoid looking at faces, thus perhaps depriving themselves of the experience that is necessary for the tuning of neuro-functional systems involved in configural face processing. This hypothesis is also supported by a recent event-related fMRI study from our group which found heightened right amygdala activation, but reduced bilateral fusiform face area activation in response to unfamiliar faces among a group of extremely shy adults (Beaton, Schmidt, Schulkin, Antony, Swinson and Hall, in press). Given that accurate face recognition is critical to social interaction, deficits in face processing may underlie some of the negative secondary effects (i.e., social problems) observed in shy individuals.

The Context-Specificity of Shyness

The phenotypic expression of shyness may be context-dependent. A recent study from our laboratory (Brunet and Schmidt, 2007) indicated that certain expressions of shyness can be masked in particular contexts. Compared to non-shy adults, those who were high in shyness exhibited significantly fewer prompted self-disclosures to strangers during a computer mediated communication, only in the presence of a live webcam stream. When the visual cues associated with the webcam stream were removed, differences in self-disclosure between the groups ceased to be significant. This suggests that the expression of shyness is not uniformly expressed across all domains, but rather that it is tempered by some degree of plasticity. The context-specific nature of shyness has also been noted in non-human species (Wilson and Stevens, 2005).

Summary

Recent research indicates that functional polymorphisms in genes encoding for proteins that are involved in the transportation and regulation of amine transmitters are associated with individual differences in aspects of personality and temperament. However, genotypes do not exist independently from the environmental constraints (both exogenous and endogenous) that facilitate and regulate their expression, and a complete picture of development emerges only when we consider the full implications of this genotype-environment interplay. The endophenotype concept offers a way to capture the intermediate or middle level of function that emerges from genotype-environment interactions (Caspi and Moffitt, 2006). Endophenotypes refer to the foundational neurophysiological, endocrinological, neuroanatomical or neuropsychological constructs that are interposed between the hidden genomic level of analysis and observable phenotypic expression (Gottesman and Gould, 2003). Theoretically derived non-invasive psychophysiological methods represent the most direct way of indexing this middle-level of analysis (Segalowitz and Schmidt, 2007). The data presented in this chapter suggest that some of the endophenotypes relevant to the study of temperamental shyness include greater relative resting right frontal EEG activity, elevated salivary cortisol (with a shift toward lowered cortisol levels in adulthood), and a high and stable resting heart rate. The collection of these endophenotypes constitutes a kind of latent potentiality that subsequently interacts with specific stressors and contextual variables to influence the phenotypic expression of shyness.

WHY STUDY TEMPERAMENTAL SHYNESS?

Theoretical Implications

Temperamental shyness represents a multi-dimensional construct that yields data at both psychological and physiological levels. The study of temperament, therefore, offers a fertile ground for integrating insights and methodology from a variety of disciplines, including affective neuroscience, psychiatry, personality and developmental psychology. The

convergence of different experimental approaches and methods onto a common area of inquiry can yield theoretical riches. The study of temperamental shyness may also be able to inform us about the complex neurodynamics that sustain relatively stable patterns of behavior and structure person-environment interactions in typical human development.

Practical Implications

There are also compelling practical reasons for studying temperamental shyness. For instance, behavioral inhibition that remains consistent over the first few years of post-natal life represents a pathogenesis factor for the development of anxiety disorders in later childhood and adolescence (Hayward et al., 1998; Hirshfeld et al., 1992). Temperamental shyness has also been linked to the emergence of social phobia (Biederman et al., 2001; Schwartz et al., 1999) and depression (Schmidt and Fox, 1995). In addition, pre-morbid shyness can exacerbate concurrent social difficulties in adults with schizophrenia (Goldberg and Schmidt, 2001; Jetha, Schmidt, and Goldberg, 2007, in press). The clinical implications of temperamental shyness emphasize the importance of its early identification. By indexing salient psychophysiological markers of temperamental shyness early in development, steps might be taken to offset its trajectory and reduce the risk of later psychopathology.

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REFERENCES

- Adamec, R.E. (1991). Individual differences in temporal lobe sensory processing of threatening stimuli in the cat. *Physiology and Behavior*, *49*, 445-464.
- Beaton, E. A., Schmidt, L. A., Ashbaugh, A. R., Santesso, D. L., Antony, M. M., McCabe, R. E., et al. (2006). Low salivary cortisol levels among socially anxious young adults: Preliminary evidence from a selected and a non-selected sample. *Personality and Individual Differences*, *41*(7), 1217-1228.
- Beaton, E.A., Schmidt, L.A., Schulkin, J., Antony, M.M., Swinson, R.P., and Hall, G.B. (2008). Different neural responses to stranger and personally familiar faces in shy and bold adults. *Behavioral Neuroscience*, *122*, 704-709.
- Beaton, E.A., Schmidt, L.A., Schulkin, J., Antony, M.M., Swinson, R.P., and Hall, G.B. (In Press). Different fusiform activity to stranger and personally-familiar faces in shy and social adults. *Social Neuroscience*.

- Benjamin, J., Li, L., Patterson, C., Greenberg, B.D., Murphy, D.L., and Hamer, D.H. (1996). Population and familial association between D4 dopamine receptor gene and measures of novelty seeking. *Nature Genetics*, *12*, 81-84.
- Biederman, J., Hirshfeld-Becker, D.R., Rosenbaum, J.F., Perenick, S.G., Wood, J., and Faraone, S.V. (2001). Further evidence of association between behavioral inhibition and social anxiety in children. *American Journal of Psychiatry*, *158*, 1673-1679.
- Broadhurst, P.L. (1975). The Maudsley reactive and nonreactive strains of rats: A survey. *Behavior Genetics*, *5*(4), 299-319.
- Brunet, P.M., Mondloch, C.J., and Schmidt, L.A. (submitted). Shy children show deficits on some aspects of face recognition. *Manuscript submitted for publication*.
- Brunet, P., and Schmidt, L.A. (2007). Is shyness context specific? Relation between shyness and online self-disclosure with and without a live webcam in young adults. *Journal of Research in Personality*, *41*, 938-945.
- Calkins, S.D., Fox, N.A., and Marshall, T.R. (1996). Behavioral and physiological antecedents of inhibited and uninhibited behavior. *Child Development*, *67*(2), 523-540.
- Caspi, A., and Moffitt, T.E. (2006). Gene-environment interactions in psychiatry: Joining forces with neuroscience. *Nature Reviews Neuroscience*, *7*(7), 583-590.
- Caspi, A., Snugden, K., Moffitt, T.E., Taylor, A., Craig, I.W., Harrington, H., McClay, J., Mill, J., Martin, J., Braithwaite, A., and Poulton, R. (2003). Influence of life stress on depression: Moderation by a polymorphism in the 5-HTT gene. *Science*, *301*, 386-389.
- Cheek, J.M., and Buss, A.H. (1981). Shyness and sociability. *Journal of Personality and Social Psychology*, *41*, 330-339.
- Cheek, J.M., and Melchoir, L.A. (1990). Shyness, self-esteem, and self-consciousness. In H. Leitenberg (Ed.), *Handbook of Social and Evaluation Anxiety* (pp. 47-82). New York: Plenum Press.
- Crozier, W.R. (1981). Shyness and self-esteem. *British Journal of Social Psychology*, *20*, 220-222.
- Davidson, R.J., and Irwin, W. (1999). The functional neuroanatomy of emotion and affective style. *Trends in Cognitive Sciences*, *3*(1), 11-21.
- Deary, I.J., Battersby, S., Whiteman, M.C., Connor, J.M., Fowkes, F.G., and Harmor, A. (1999). Neuroticism and polymorphisms in the serotonin transporter gene. *Psychological Medicine*, *29*, 735-739.
- Ebstein, R.P., Novick, O., Umansky, R., Priel, B., Osher, Y., Blaine, D., Bennett, E.R., Nemanov, L., Katz, M., and Belmaker, R.H. (1996). Dopamine D4 receptor (D4DR) exon III polymorphism associated with the human personality trait of novelty seeking. *Nature Genetics*, *12*, 78-80.
- Fox, N.A. (1991). If it's not left, it's right: Electroencephalographic asymmetry and the development of emotion. *American psychologist*, *46*, 863-872.
- Fox, N.A., Calkins, S.D., and Bell, M.A. (1994). Neural plasticity and development in the first two years of life: Evidence from cognitive and socioemotional domains of research. *Development and Psychopathology*, *6*, 677-696.
- Fox, N.A., Henderson, H.A., Rubin, K.H., Calkins, S.D., and Schmidt, L.A. (2001). Continuity and discontinuity of behavioral inhibition and exuberance: Psychophysiological and behavioral influences across the first four years of life. *Child Development*, *72*, 1-21.

- Fox, N.A., Nicols, K., Henderson, H., Rubin, K.H., Schmidt, L.A., Hamer, D., Ernst, M., and Pine D.S. (2005). Evidence for a gene-environment interaction in predicting behavioral inhibition in middle childhood. *Psychological Science*, *16*, 921-926.
- Fox, N.A., Rubin, K.H., Calkins, S.D., Marshall, T.R., Coplan, R.J., Porges, S.W., Long, J.M., and Stewart, S. (1995). Frontal activation asymmetry and social competence at four years of age. *Child Development*, *66*, 1770-1784.
- Fox, N.A., Schmidt, L.A., Calkins, S.D., Rubin, K.H., and Coplan, R.J. (1996). The role of frontal activation in the regulation and dysregulation of social behavior during the preschool years. *Development and Psychopathology*, *8*, 89-102.
- Fries, E., Hesse, J., Hellhammer, J., and Hellhammer, D.H. (2005). A new view on hypocortisolism. *Psychoneuroendocrinology*, *30*, 1010-1016.
- García Coll, C., Kagan, J., and Reznick, J.S. (1984). Behavioral inhibition in young children. *Child Development*, *55*, 1005-1019.
- Goldberg, J.O., and Schmidt, L.A. (2001). Shyness, sociability, and social dysfunction in schizophrenia. *Schizophrenia Research*, *48*, 343-349.
- Gottesman, I.L., and Gould, T.D. (2003). The endophenotype concept in psychiatry: Etymology and strategic intentions. *American Journal of Psychiatry*, *160*, 636-645.
- Hariri, A.R., Mattay, V.S., Tessitore, A., Kolachana, B., Fera, F., Goldman, D., Egan, M.F., and Weinberger, D.R. (2002). Serotonin transporter genetic variation and the response of the human amygdala. *Science*, *297*, 400-403.
- Hayward, C., Killen, J.D., Kraemer, H.C., and Taylor, C.B. (1998). Linking self-reported childhood behavioral inhibition to adolescent social phobia. *Journal of the American Academy of Child and Adolescent Psychiatry*, *37*, 1308-1316.
- Hirshfeld, D.R., Rosenbaum, J.F., Biederman, J., Bolduc, E.A., Faraone, S.V., Snidman, N., Reznick, J.S., and Kagan, J. (1992). Stable behavioral inhibition and its association with anxiety disorder. *Journal of the American Academy of Child and Adolescent Psychiatry*, *31*, 103-111.
- Hirshfeld-Becker, D.R., Biederman, J., Henin, A., Faraone, S. V., Davis, S., Harrington, K., and Rosenbaum, J.F. (2007). Behavioral inhibition in preschool children at risk is a specific predictor of middle childhood social anxiety: A five-year follow-up. *Journal of Developmental and Behavioral Pediatrics*, *28*, 225-233.
- Jetha, M.K., Schmidt, L.A., and Goldberg J.O. (2007). Stability of shyness, sociability, and social dysfunction in schizophrenia: A preliminary investigation of the influence of social skills training in a community-based outpatient sample. *European Journal of Psychiatry*, *21*, 189-198.
- Jetha, M.K., Schmidt, L.A., and Goldberg J.O. (In press). Resting frontal EEG asymmetry and shyness and sociability in schizophrenia: A pilot study of community-based outpatients. *International Journal of Neuroscience*.
- Kagan, J. (1994). *Galen's prophecy: Temperament in human nature*. New York: Basic Books.
- Kagan, J. (1999). The concept of behavioral inhibition. In L.A. Schmidt and J. Schulkin (Eds.), *Extreme Fear, Shyness and Social Phobia: Origins, Biological Mechanisms and Clinical Outcomes* (pp. 3-13). New York: Oxford University Press.
- Kagan, J., Reznick, J. S., and Snidman, N. (1987). The physiology and psychology of behavioral inhibition in children. *Child Development*, *58*(6), 1459-1473.

- Kagan, J., Reznick, J.S., Snidman, N. (1988). Biological bases of childhood shyness. *Science*, 240, 167-171.
- Kagan, J., and Snidman, N. (1991). Infant predictors of inhibited and uninhibited profiles. *Psychological Science*, 2(1), 40-44.
- Kaufman, J., Yang, B.Z., Douglas-Palumberi, H., Houshyar, S., Lipschitz, D., Krystal, J.H., and Gelernter, J. (2004). Social supports and serotonin transporter gene moderate depression in maltreated children. *Proceedings of the National Academy of Sciences, USA*, 101, 17316-17421.
- Kumakiri, C., Kodama, K., Shimizu, E., Yamanouchi, N., Okada, S., Noda, S., Okamoto, H., Sato, T., and Shirasawa, H. (1999). Study of the association between the serotonin transporter gene regulatory region polymorphism and personality traits in a Japanese population. *Neuroscience Letters*, 263, 205-207.
- Lahey, B.B. (2004). Role of temperament in developmental models of psychopathology: Commentary. *Journal of Clinical Child and Adolescent Psychology*, 33, 88-93.
- Lang, P.J. (1995). The emotion probe: Studies of motivation and attention. *American Psychologist*, 50, 372-385.
- Le Grand, R., Mondloch, C. J., Maurer, D., and Brent, H. P. (2003). Expert face processing requires visual input to the right hemisphere. *Nature Neuroscience*, 6, 1108-1112. Erratum: 2003, 8, 1329.
- Lesch, K.P., Bengel, D., Heils, A., Sabol, S.Z., Greenberg, B.D., Petri, S., Benjamin, J., Muller, C.R., Hamer, D.H., and Murphy, D.L. (1996). Association of anxiety-related traits with a polymorphism in the serotonin transporter gene regulatory region. *Science*, 274, 1527-1531.
- Pérez-Edgar, K., and Fox, N.A. (2005). Temperament and anxiety disorders. *Child and Adolescent Psychiatric Clinics of North America*, 14, 681-706.
- Pilkonis, P. A. (1977). The behavioral consequences of shyness. *Journal of Personality*, 45, 596-611.
- Plomin, R. (1986). *Development, Genetics, and Psychology*. Hillsdale, NJ: Erlbaum.
- Rosen, J.B., Hamerman, E., Sitcoske, M., Glowa, J.R. and Schulkin, J. (1996). Hyperexcitability: Exaggerated fear-potentiated startle produced by partial amygdala kindling. *Behavioral Neuroscience*, 102, 195-202.
- Rosenbaum, J.F., Biederman, J., Bolduc-Murphy, E.A., and Faraone, S.V. (1993). Behavioral inhibition in childhood: A risk factor for anxiety disorders. *Harvard Review of Psychiatry*, 1(1), 2-16.
- Rothbart, M.K. (1981). Measurement of temperament in infancy. *Child Development*, 52, 569-578.
- Schmidt, L.A. (1999). Frontal brain electrical activity in shyness and sociability. *Psychological Science*, 10, 316-320.
- Schmidt, L.A., and Fox, N.A. (1994). Patterns of cortical electrophysiology and autonomic activity in adults' shyness and sociability. *Biological Psychology*, 38, 183-198.
- Schmidt, L.A., and Fox, N.A. (1995). Individual differences in adults' shyness and sociability: Personality and health correlates. *Personality and Individual Differences*, 19, 455-462.
- Schmidt, L.A., and Fox, N.A. (1998). Fear-potentiated startle responses in temperamentally different human infants. *Developmental Psychobiology*, 32(2), 113-120.

- Schmidt, L.A., and Fox, N.A. (1999). Conceptual, biological, and behavioral distinctions among different categories of shy children. In L.A. Schmidt and J. Schulkin (Eds.), *Extreme Fear, Shyness and Social Phobia: Origins, Biological Mechanisms and Clinical Outcomes* (pp. 47-66). New York: Oxford University Press.
- Schmidt, L.A., and Fox, N.A. (2002). Molecular genetics of temperamental differences in children. In J. Benjamin, R.P. Ebstein, and R.H. Belmaker (Eds.), *Molecular Genetics and The Human Personality* (pp. 247-257). Washington, DC: American Psychiatric Association Press.
- Schmidt, L.A., Fox, N.A., and Hamer, D.H. (2007). Evidence for a gene-gene interaction in predicting children's behavior problems: Association of 5-HTT short and DRD4 long genotypes with internalizing and externalizing behaviors in seven year-old children. *Development and Psychopathology, 19*, 1103-1114.
- Schmidt, L.A., Fox, N.A., Pérez-Edgar, K., and Hamer, D.H. (In press). Linking gene, brain, and behavior: DRD4, frontal asymmetry, and temperament. *Psychological Science*.
- Schmidt, L.A., Fox, N.A., Pérez-Edgar, K., Hu, S., and Hamer, D.H. (2001). Association of DRD4 with attention problems in normal childhood development. *Psychiatric Genetics, 11*(1), 25-29.
- Schmidt, L.A., Fox, N.A., Rubin, K.H., and Hu, S., and Hamer, D.H. (2002). Molecular genetics of shyness and aggression in preschoolers. *Personality and Individual Differences, 33*(2), 227-238.
- Schmidt, L.A., Fox, N.A., Rubin, K.H., Sternberg, E.M., Gold, P.W., and Smith, C.C. (1997). Behavioral and neuroendocrine responses in shy children. *Developmental Psychobiology, 30*, 127-140.
- Schmidt, L.A., Fox, N.A., Schulkin, J. and Gold, P.W. (1999). Behavioral and psychophysiological correlates of self-presentation in temperamentally shy children. *Developmental Psychobiology, 35*, 119-135.
- Schmidt, L.A., Miskovic, V., Boyle, M., and Saigal, S. (2008). Shyness and timidity in young adults who were born at extremely low birth weight. *Pediatrics, 122*, e181-e187.
- Schmidt, L.A., Santesso, D.L., Schulkin, J., and Segalowitz, S.J. (2007). Shyness is a necessary but not sufficient condition for high salivary cortisol in typically developing 10 year-old children. *Personality and Individual Differences, 43*, 1541-1551.
- Schmidt, L.A., and Schulkin, J. (Editors). (1999). *Extreme Fear, Shyness, and Social Phobia: Origins, Biological Mechanisms, and Clinical Outcomes*. New York: Oxford University Press.
- Schulkin, J., and Rosen, J.B. (1999). Neuroendocrine regulation of fear and anxiety. In L.A. Schmidt and J. Schulkin (Eds.), *Extreme Fear, Shyness and Social Phobia: Origins, Biological Mechanisms and Clinical Outcomes* (pp.140-172). New York: Oxford University Press.
- Schwartz, C.E., Snidman, N., and Kagan, J. (1999). Adolescent social anxiety as an outcome of inhibited temperament in childhood. *Journal of the American Academy of Child and Adolescent Psychiatry, 38*(8), 1008-1015.
- Schwartz, C.E., Wright, C.I., Shin, L.M., Kagan, J., and Rauch, S.L. (2003). Inhibited and uninhibited infants "grown up": Adult amygdalar response to novelty. *Science, 300*, 1952-1953.
- Segalowitz, S.J., and Schmidt, L.A. (2007). Capturing the dynamic endophenotype: A developmental psychophysiological manifesto. In L.A. Schmidt and S.J. Segalowitz

- (Eds.), *Developmental Psychophysiology: Theory, Systems, and Methods* (pp. 1-12). New York: Cambridge University Press.
- Snidman, N., and Kagan, J. (1994). The contribution of infant temperamental differences to acoustic startle response [Abstract]. *Psychophysiology*, *31*, S92.
- Stevenson-Hinde, J. (2000). Shyness in the context of close relationships. In W.R. Crozier (Ed.), *Shyness: Development, Consolidation and Change* (pp. 88-102). London: Routledge, Taylor and Francis Group.
- Theall-Honey, L.A., and Schmidt, L.A. (2006). Do temperamentally shy children process emotion differently than nonshy children? Behavioral, psychophysiological, and gender differences in reticent preschoolers. *Developmental Psychobiology*, *48*(3), 187-196.
- Van Tol, H.H.M., Wu, C.M., Guan, H.C., Ohara, K., Bunzow, J.R., Civelli, O., et al. (1992). Multiple dopamine D4 receptor variants in the human population. *Nature*, *358*, 149-152.
- Wilson, A.D.M., and Stevens, E.D. (2005). Consistency in context-specific measures of shyness and boldness in rainbow trout, *oncorhynchus mykiss*. *Ethology*, *111*, 849-862.

Chapter 6

THE SUGGESTIVE IMPACT OF COGNITIVE ILLUSIONS ON INTERACTIVE INFORMATION EXCHANGE PROCESSES ON TERRORISM

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ABSTRACT

During recent decades, fear about terror acts has risen. This development was and is supported by the increasing vulnerability of industrial societies (e.g., due to nuclear power plants and terrorists' attacks, e.g., in the Far East or 9/11). These tendencies influenced not only political decisions but the course of everyday life as well. As those events are extreme and rare, the psychological consequences and processes involved are so far relatively unknown. We discuss a possible framework for explaining these new developments by feasible psychological theories. A suitable approach is the Cumulative Prospect Theory (CPT) by Tversky and Kahneman (1992). According to CPT, rationality is defined in respect to subjective reference points rather than to general objective criteria. The possibilities of explaining and predicting different definitions of rationality by means of CPT are discussed. Other features of CPT relevant in this context are cognitive illusions like the representative heuristic and availability heuristic. These heuristics cause a subjective representation of events that is not appropriate according to rational criteria. Therefore, such biases explain why terror events appear to be a real harassment in everyday life even though they are statistically less likely to occur than other incidents (e.g., traffic accidents). We also discuss the possibility of explaining the psychological processing of information dealing with terror threats by other phenomena known in the psychology of heuristics, biases and errors that are not explicitly addressed in CPT. These are the so-called validity, misinformation and labeling effects, illusionary correlations and the peculiarities involved when flashbulb memories are processed. Finally, the subject area of the psychology of suggestion will be addressed as a possible framework for these theories, heuristics and effects.

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INTRODUCTION

Why do events like the terrorist attacks in New York in 2001 or in Madrid in 2003 have far-reaching consequences? To what extent do those incidents influence people who try to use these events for their own purposes and why do whole nations follow them? These extensive events are of high interest, particularly in psychology because, despite their rarity, they influence the bearing of whole nations and cultural groups. Governments of Western civilizations provide enormous budgetary funds; people restrict their civil rights and freedom inherited by their ancestors in order to prevent a terrorist attack. In addition, the market economy is becoming more sensitive concerning the issue of terror. Minor conflicts in the Middle East suffice to raise oil prices immeasurably.

But what are the reasons for this behavior and why are millions of people so sensitive to and dirigible by this topic? We will attempt to find some answers to these questions and we will present some psychological theories that could help to explain the circumstances. Without a doubt the terrorist attacks of September 11, 2001 have been traumatic for a lot of people. There were thousands of casualties as well as injured people and the whole world witnessed it. This incident at the beginning of the 21st century has shown enormous effects until now. One decade after the time of the Cold War, Western civilization was confronted with a new enemy—at least from the politicians' point of view. The interests of influential persons have unjustifiably benefited from the anxiety of the American population until today. Only some days after the terrorist attacks on October 7, 2001, US forces began "Operation Enduring Freedom" and marched into Afghanistan. On March 19, 2003, the United States attacked Iraq, and a new "Axis of Evil" was born—especially from the American President's point of view. But how can the fact that there was only little opposition to and great encouragement of Western civilization be explained? Strictly speaking, the likelihood of an American soldier losing his life in the Iraq War is higher than dying as a victim in a terrorist attack like those thousands of people on September 11.

The MCA (maximum credible accident) at Chernobyl can be regarded as another example of a rare happening with far-reaching consequences. From a rational point of view, the reason that the risks of nuclear energy are more frequently discussed than hazards of other energy sources (e.g., Vlek, 1999) is elusive. The probability of the recurrence in modern nuclear power plants of such a catastrophe like the one in Chernobyl could—at least statistically—be ignored. Nowadays, in times of increasing energy costs and a worldwide shortage of energy, there is, e.g., in Germany no opposition to shutting down nuclear power plants. How could this be explained? Why have such rare but extreme happenings as described above had such far-reaching consequences on the experience and behavior of human beings?

Rationality is not a collectivistic concept; it is different from group to group and often different between individuals. This explains the different kinds of reactions to one and the same incident.

DEFINITION OF “RATIONALITY”

As a starting point, we take the concept of “bounded rationality” by Simon (e.g., 1997) and Elster (1989). According to this concept, there is not enough information available to an individual in a constantly changing environment to achieve a maximization of benefit. Consequently, the individual stops searching for benefit, if it seems advantageous to his individual needs—thus a status has been accomplished, which is satisfactory to this individual. This can even be possible if the result is far below the potential benefit. This status is called “satisficing” by Simon. The collective term of bounded rationality also includes the application of the heuristics, which are given below.

In the 21st century and as well as in the predominant disputes, which are mainly based on religious differences, satisficing has a basic relevance. What else could be the explanation for suicide bombing? Psychopathological inquiries have shown that there are no distinctive features of suicide bombers in comparison to average citizens (Davis, 2003; Reuter 2004; Stern 2003; Victor 2003). The belief to enter paradise as a martyr in the name of “Jihad” is the main reason for a lot of young men to feel—in the name of holy war—contentment with the expectation of a promised world and to stop searching for other options to gain entrance into the paradise in a different way.

The relevant works of other authors that demonstrate the impact of bounded rationality on the 21st century are the former Federal Chancellor Gerhard Schröder and the President of the United States, George W. Bush. Schröder achieved the point of satisfaction when the Germans pledged “total solidarity” with the US, but only within the bounds of UN-Resolution 1368. This was the Federal Chancellor’s contribution to the fight against terrorism, and because of this he was able to preserve the closing of ranks to the ally, the US. The above-mentioned “total solidarity” had its limits—namely, when the US marched into Iraq. On the other hand, the American President was not content with the banishment of the Taliban regime. The government of the United States was—according to media reports—fishing for reasons to topple another terror regime—the one of Saddam Hussein.

But differences according to different definitions of rationality cannot account for all contrary points of view. Even within a consistent frame of rationality, many examples have shown that the *homo oeconomicus*, who is hypothesised by theories on rationally acting individuals, is prone to make systematically wrong decisions and hence is not acting rationally. As for these differences, errors and biases are responsible for an effect on risk perception.

THE IMPACT OF “BIG BANG EVENTS” ON OUR FAULTY AND BIASED RISK PERCEPTION

But why have events like the attacks of September 11, the disaster of Chernobyl or the attacks on Pearl Harbor had such a great impact on our risk perception and thus on our behavior, even though they are unique?

According to Tversky’s and Kahneman’s (1992) Cumulative Prospect Theory, the coincidence of rareness and the extreme is the reason that people act in a disadvantageous way, although, according to the rational decision theory, they should be aware of the rareness

and should not pay so much attention to these events. This theory is a modification of the primordial Prospect Theory (PT) (Kahneman and Tversky, 1979). One essential part of the PT is the invariance principle, which transfers on the framing of a status and the different representation of framing. Levin, Schneider and Gaeth (1998) differentiate between three different kinds of framing, two of which are of specific interest for us. *Risk choice framing*, introduced by Tversky and Kahneman (1981), has an impact on the risk preference. By this kind of framing decisions in the process of making a choice are influenced when different risk levels are described in different ways. A decision in favor of the safe or risky alternatives depends on whether the problem is illustrated as a profit or a loss.

Tversky and Kahneman (1981) illustrate the framing effect by means of an experiment involving two decision tasks. As to the first task the participants had to imagine that the USA is preparing for an outbreak of an Asian disease and they expect it would kill 600 people. The United States proposed two alternative programs to fight this disease. Then the participants had to assume that the exact scientific estimate of the consequence of the programs are that if program A were adopted, 200 people would be saved (72 per cent) and if program B were adopted, there would be a 1/3 probability that 600 people would be saved, and a 2/3 probability that no person will be saved (28 per cent). Then the participants had to decide for one of these programs. More test persons opted for option A than for option B. Consequently the prospect of certainly saving 200 lives is more attractive than a risky prospect of equally expected value, that is, a one-in-three chance of saving 600 lives (Tversky and Kahneman, 1981). In the second task the participants had to imagine the two cases that if program C were adopted 400 people would die (22 per cent) and if program D were adopted, there would be a 1/3 probability that nobody would die, and a 2/3 probability that 600 people would die (78 per cent). Here the majority prefers the choice D. Each of these programs (A, B, C, D) has the same expected value for the outcomes, because in each of these programs 400 people would die and 200 people would be saved. The difference between the first and the second option within each pair of alternatives is the presence of uncertainty. The difference between the first and second problems is the framing of the alternatives in terms of “lives saved” or “lives lost”. The scheme of proceeding observed in this and other experiments is that “choices involving gains are often risk averse and choices involving losses are often risk taking”.

Another relevant kind of framing is *goal framing* (Levin et al., 1998). *Goal framing* influences behavior by strategies of persuasion and conviction. With this kind of framing the positive consequences of acting and the negative consequences of the forbear of acting are specially emphasized.

If the media and policy in 1986 had illustrated the worst case scenario of Chernobyl not only as a singular case but also as a constructional fault of the system and if they had shown to the population that the danger of nuclear power is not bigger than, e.g., energy produced of coal, the event would have had very different consequences. In this case PT would compare this fictitious framing with the one after this disaster and decide explicitly in profit and loss contexts. The PT and its derivate—the CPT—can be instrumental to predict decisions in complex situations even better than the Expected Utility Theory (EUT) would do. EUT is a generally accepted *prescriptive* theory predicting how people *should* decide. According to the EUT preferences should be founded on a simple rational calculus: If at least two different options (at least one of them should occur uncertainly) can be chosen, according to EUT the option with the higher expected utility (resulting from the probability of occurrence multiplied by its value) should be chosen. In our case the question is, if a government should

activate all national systems to realise a 100 per cent safety-plan against new terrorist attacks or if the government should not do more than is absolutely necessary, because the probability of an new attack (in this form) is rather small. Kahneman and Tversky (1979) call this option a “Prospect”, which results from an outcome and the occurrence probability. According to PT individuals make decisions that are not explicable in terms of rational decision criteria like the EUT. This is due to (1) different cognitive processes and phenomena and the shapes of the (2) utility and (3) probability weighting functions. In the following sections we will refer to these features. As for the cognitive processes and phenomena we will relate to those which are most relevant for the scope of our chapter.

In PT and CPT Kahneman and Tversky (1979, 1992) differentiate between two phases of decision processes: In the *editing*-phase different processes that are all instrumental to simplify later evaluation processes occur. Some of these processes are coding, combination and simplification. Anticipated outcomes of decisions are *coded* as gains or losses and the current status is regarded as a point of reference. Past 9/11 another terrorist attack would have been coded as a loss. According to the value function PT and CPT losses are valued more negatively than gains positively (compare Figure 1). Consequently, the public is willing to accept the imposing of restrictions in order to avoid such a big loss. The operation of *combination* describes the process, in which diverse probabilities all causing the same outcome, are cumulated to a total probability. If politics communicated that a new attack could be avoided using alternative A with a probability of 15 per cent and using B with a probability of 23 per cent, the same event—no new attack—would be accomplishable to an individual with a probability bigger than 23 per cent. *Simplification* strategies often suggest to ignore extreme low probabilities. As a matter of that the public refuses to take the low base rate for extreme incidents like terror act into account.

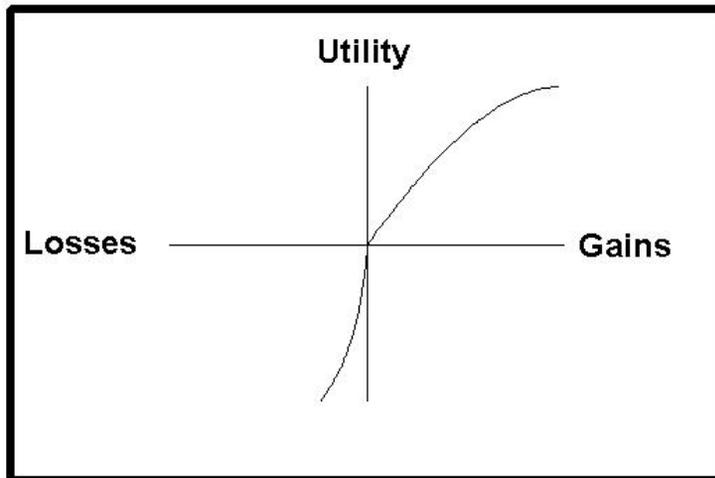


Figure 1. Utility function according to PT (Kahneman and Tversky, 1979).

In the *evaluation-phase* the previously edited results are multiplied by a subjective decision weight, which is a decisive aspect of the explanation of our facts, because whereas the PT describes the subjective course of action, the result should—according to statistical guidelines for the formation of an expectancy value—merely be multiplied by the occurrence probability, which would in the case of terrorist attacks mean that such an event could be excluded. Consequently, the weighting function (see Figure 2) is not in line with the axioms of the calculus of probabilities. Low probabilities are over-estimated and that despite this overvaluation of low probabilities the sum of all weighted functions is often below 1. This is the so-called the subcertainty effect. Middle and higher probabilities are underestimated. In case of very low probabilities Tversky and Kahneman (1979) did not assign a decision weight because—as mentioned above—such probabilities are often ignored as a result of the simplification process.

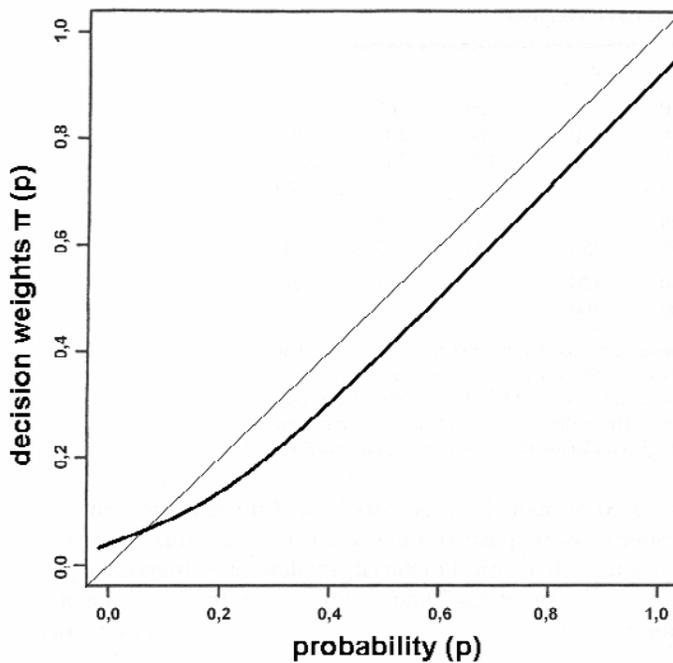


Figure 2. Weighting of probabilities in Prospect Theory (Kahneman and Tversky, 1979).

This definition of decision weights was confronted with methodological criticism, so that as a result Tversky and Kahneman (1992) revised their theory and redefined it into CPT. The difference is the weighted function for profits and losses. In this version the end points are also well defined, whereby the sum of weighted functions is 1. This is an advantage of the CPT model. But there are empirical references for the fact that empirical findings corroborates the version of the PT with unweighted extremes (c.f., e.g., Dusenbury and Fennema, 1996). Moreover, the profit curve is rounder in its run, which reflects the distinct risk aversion in profit situations in contrast to the risk propensity in loss contexts. This function leads as well to the overweighting of lower and the underweighting of higher probabilities (see Figure 3)

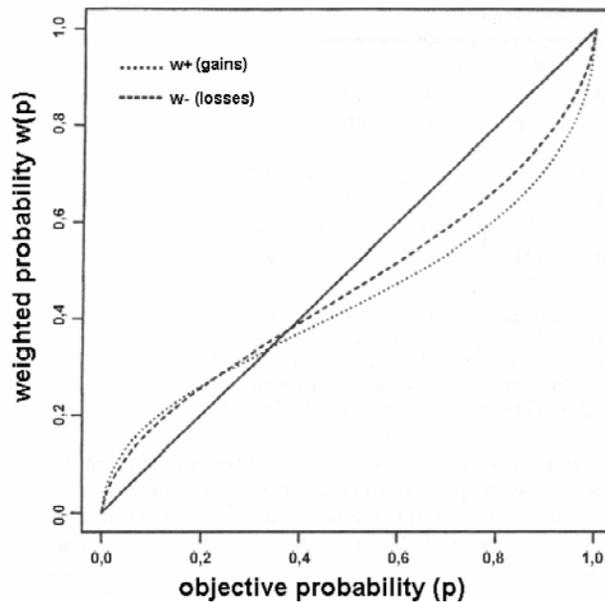


Figure 3. Weighting of probabilities in Cumulative Prospect Theory (Tversky and Kahneman, 1992).

According to CPT the accumulation of an expected benefit does not happen because of the effective occurrence probability of environment status, but on the basis of a replacement of the occurrence probabilities by so-called probability weights. Furthermore there is an overweighting of very low probabilities and a coexistent underweighting of very high probabilities. This is the reason why some of us buy lottery tickets despite the knowledge, how unlikely the chance to win is and despite the high prices for such tickets. This is also an explanation of the attempted prevention against unlikely terrorist attacks. Permanent coverage of media and politics about the assumed danger of new attacks contribute to this effect. Through this continuous presence the focus of our attention keeps being turned to these circumstances and is ready for permanent demand: Kahneman and Tversky (1974) asked the participants to read lists with masculine and feminine names. The lists were arranged in a way that a gender was represented by famous names, whereby the other gender was represented by imaginary names. The number of masculine and feminine names was the same. Then the participants had to quote, which gender had more names in its list. The experimenters found a significant effect to that effect that most participants maintained to have found more names of the gender containing famous people. From this the scientists concluded that it is easier for participants to remember famous names, which is nowadays known as the “Famous Names Effect”, which is related to the *availability heuristic*. Similar to the fact that participants in this experiment were able to remember the names of famous people, the permanent danger of a terrorist attack is constantly present because of continuous coverage by the media and politics. This is expandable to the extent that this effect gets stronger, if not only the permanent presence of a possible danger increases but if the person propagating it is present as well. Hypothetically there could be a stronger effect, if the US President spoke of this terrorist danger, than if any student statistically proved that this danger could be neglected, because it is theoretically minimal.

Several studies related to the Prospect Theory by Tversky and Kahneman (1974, 1981) identified several heuristics and biases like the above mentioned *availability* and *representative heuristics*, all of them influencing the decision making of an individual. The *heuristic of anchoring and adjustment* could explain, why the perceived probability to fall victim to a terrorist attack is overestimated. Strong media coverage enhances subjective probabilities. One alternative explanation for such high subjective probabilities is the above mentioned availability heuristic. The advantage of the heuristic of anchor-and-adjustment is that it is more parsimonious since it does not imply an intensive cognitive confrontation with an inherent drama which would be a prerequisite for a strong cognitive representation causing a high cognitive availability.

Other consequences of these heuristics are that once taken positions will not be given up without resistance and the *status quo bias*, according to which people make all efforts to preserve the status quo rather than to change the situation. This bias also leads to the effect that people bemoan the losses disproportionately without having any profit by doing so.

Another of these biases is the *overconfidence bias*. In addition this bias causes the overassessment of personal skills, the anticipated influence on future, e.g., through the fight against terrorism. This bias also causes the valuation of rivals' skills. This could be an explanation of why Western governments regard the system of their state as the best one and in case of need try to export that system without consideration by means of war.

The experiments of Tversky and Kahneman (1983) also advert to the *conjunction fallacy*. This effect describes that individuals connect two in fact totally independent events. Researches on the conjunction fallacy prove that events are overestimated when these events present a seemingly plausible explanation (Thüring and Jungermann, 1990). So the probability of a new attack on the September 11, 2002, the anniversary, was considered to be relatively high, because of an implied causal correlation to assumed terrorists.

Powerful people also use the *misinformation effect* for attaining their ends. This effect relates to absorption of false information. There has not to be concrete information in a special situation to acquire this effect, but suggestive questions suffice as well. If individuals make a declaration to a special event, and get accordingly false information about the same event, the following estimations about the incidence are biased by the incorrect blurbs. Loftus and Palmer (1974) showed participants a film about a car accident. Afterwards, they were asked to estimate the speed of the crashed vehicles. The diction affected the estimations of the participants. If the experimenter asked about the speed when they "contacted", the speed was estimated to be lower as if the experimenter asked about the speed, when the cars "smashed". The misinformation effect could be explained by the activation of a node within the semantic network memory causing an activation of ambient nodes. If a node is often activated, its associated information becomes easier available, no matter whether the information is right or wrong. Therefore, memories could be affected by a priming of false information. The iterated offering of false information after the traumatic event of 09/11, could bias the memories of individuals, who experienced the cruel act. The conscious communication of false information could be a possible tool for powerful rulers to get their will.

Another possible explanation offers the *validity effect*, which is also known as the *illusory truth effect*. This one deals with the phenomena, that credibility of a declaration rises with the times of its representation to an individual. In our example, the representation rate of a specific situation crucially affects the perceived validity of falling victim to a terrorist act. Hasher, Goldstein und Toppino (cited in Schwarz, 1982) investigated the validity effect at

first. They conducted a study in which participants estimated three times the credibility of different statements three times fortnightly intervals. The experimenters varied the frequency of statements, so that some statements occurred altogether three times, while other statements were shown only once. The authors reported that participants rated statements, which were seen three times, as significant more authentic, than statements, which were viewed only once. Hasher, Goldstein and Toppino interpreted the findings suchlike, that individuals are more convinced by the authenticity and validity of a statement, if the statement is more familiar by more frequent presentation.

An interesting question refers to the changed attitudes toward some groups of population. The majority of the terrorists of 9/11 descended from the Arabian region; hence the point of view about the Islamic World by the Western culture has been dramatically altered. What could be the effects of 9/11 concerning the social interaction of individuals belonging to different cultures? Is it true that people of Islamic countries are judged in a more critical way and if this is the case, which theories can explain these circumstances? For some time past, the media has been reporting about problems of the Western culture with the Islamic world: Suicide attacks or the suppression of terror cells bare discussed regularly. Maybe, the frequent media presence of suchlike topics leads to an enhanced cognitive availability of problematic behavior on part of the Islamic population and to an overestimation of the actual incidence of criminal behavior of the class of population. Such an overestimation of the coherence between two variables is due to an *illusory correlation*. Thereby, a connection is built although none exists, or the strength of a connection is overestimated. In our example, the correlation of the variables "Islamic" and "criminality" is overestimated, since the lasting media reports about the clash of the civilizations convey to an expectation, that these two features covariate with each other. Such expectancy based illusory correlations may be lead to a heightened suspicion of Arabian fellow citizens, if a terrorist act has happened. The true coherence between criminality and nationality (visualised by a four fields table) is disregarded. In an often-cited study, Hamilton and Gifford (1976) showed that negative happenings are associated stronger with minorities than majorities. Study participants received negative and positive information in the same quantity about a big and a small group. Finally, the groups were evaluated by the participants: The minority group was assessed systematically more negatively. A transference of the reported effects found in the study to the situation after 9/11 can explain the negative view of specific persons. Negative happenings are connected stronger to a minority (Islamic citizens), resulting in a worse evaluation of this population group. One can assume that such an effect is much weaker in a country with an Islamic majority. Illusory correlations convey to a worse evaluation of some social categories and explain, why many individuals are suspicious of specific social groups. A distortion of coherencies can also be clarified by unequal emphasis of information. While answering the question, whether, e.g., an Arabian person commits a crime in a special situation, the following error can occur: The feature "criminal behavior" and "Arabian" are valued stronger than "not-criminal behavior" and "not an Arabian". Figure 4 shows that an emphasis of one cell indicates a subjective overassessment of the coherence. Talking or reporting about criminal Arabian persons draws the attention off, e.g., non-Criminal Arabians (cell C) or criminal non-Arabians (cell B). This effect can be explained in terms of the availability heuristic. In addition, this effect is enhanced (1) by the *feature positive effect* (Sainsbury, 1971) and (2) by different subjective weighting of causes and consequences (Wasserman, Dorner and Kao, 1990). The feature positive effect causes that instances

representing the existence of present features (Arabian AND criminal behavior in cell A) have a higher cognitive salience than instances representing the existence of one present feature (Arabian OR criminal behavior in cells B and C) two non-present features (non-Arabian AND non-criminal behavior in cell D). In cases of cells B and C instances with a present cause have a higher salience (cell C) than instances with a present consequence (cell C, Wasserman et al., 1990).

		CAUSE	
		Arabian	Non-Arabian
CONSEQUENCE	Criminal Behavior	A	B
	Non-Criminal Behavior	C	D

Figure 4. Tabular illustration of a correlation between two dichotomous variables.

Another peculiarity of illusory correlations allegorizes the distinctiveness of extreme and rare events. The proceedings of 9/11 are encoded more exactly by the heightened attention and are stored well in memory because of their salience. If a distinct happening is accomplished by a distinct social group, this coincidence is encoded and stored more accurately. Since 9/11 was a very distinct event, which has an enormous resonance in the media, and was caused by a minority, it is probably, that thinking and judging of many people has been influenced by *illusory correlations*.

Not only thinking processes change during tragedies, but also memory processes alter essentially. Often, *flashbulb memories* appear after significant events. The impression diversity of flashbulb memories is not related to the actual information of a situation, but to the situational circumstances in the ambience, while encoding took part. There are some explanations for this kind of memory: Personal relevant happenings have a certain emotional meaning and the releasing of stress hormones leads to an enhanced memorability. Besides, it is believed that people deals with important events more detailed and accurate and this leads to a higher probability of remembering. The processing of information is in such circumstances more thorough. But what is about the quality of such memories? Are they more exact? It is likely that noteworthy proceedings bring about more accurate memories. Empirical findings present a contrary picture: Although flashbulb memories are more precise than ordinary memories (Christianson, 1989), they are far from being faultlessly. Neisser and Harsch (1992) asked students about the situation, in which they first heard about the 1987 explosion of the *Challenger*. The first consultation took place 24 hours after the tragedy, the second one succeeded two and a half year later. No one of the participants reported completely the same situation. This fact alludes to the fallibility of suchlike memories. Even if the participants were very sure about the accuracy of theirs memories, they made mistakes. It could be problematic, if people are very sure about their memories of a specific event, and they would be wrong. An interesting study was conducted by Talarico and Rubin (2003). They asked students one day after 9/11 about daily life happenings as well as about 9/11. The next investigations proceeded seven days, 42 days and 224 days later. The findings indicated that flashbulb memories continued very pictorially all the time, but consistency about the

reported memories related to 9/11 was not above consistency of common memories. A theoretical framework was presented by Conway et al. in 1994: Firstly, they propose that already existent knowledge helps to integrate the new experience in the structures of memory. Secondly, they assume personal relevance as a necessary condition. Thirdly, they point out that an event must provoke an emotional reaction and fourthly, the happening should be reversed cognitively. While the first three aspects are necessary for the development of flashbulb memories, the last one is optional.

Is it possible that Western societies effectively rear their enemy? The *labeling approach* (Quensel, 1964) assumes criminal behavior as an effect of societal normative conceptions. Quensel's *Model of Career* claims that a society reacts to an anomalous behavior with stigmatization and labels the delinquent a "criminal". The stigmatization is followed by heightened discrimination, which often leads to social exclusion of the person from the particular society. The titling as a "criminal" urges the delinquent forward to a career of crime. The outlaw fulfils his imparted role, since he has no possibility to fill a role according to the norm. A vicious circle with an advancing de-socialization prevails. However, the classic labeling approach refers to an individual and not to a group of people. Nevertheless, there are several experiments showing that there are many effects of labeling (cf., e.g., Pohl, 2004). In a classic study by Carmichael, Hogan and Walter (1932), ambiguous drawings were given different labels in two different experimental conditions. Later, when subjects were asked to draw the simple original stimulus figures, it was found that there was a tendency to modify the drawing in the direction of the label that had been paired with it. Thus, a figure that was drawn somewhat ambiguously between "number 4" and "number 7" was redrawn to look more like a "7" if it had been labeled as such previously. To summarize, effects of labeling seem to be ubiquitous processes. Thus it is highly plausible that such labeling processes made the terrorists of 9/11 felt de-socialized because Western societies refused to hand out "entry tickets" to them.

CONCLUSION

We tried to identify theories and findings that can contribute to the understanding of the communication of terrorism. We only mentioned the best-funded concepts. Nevertheless, their number is quite high. Therefore, we suspect that all of these concepts could be conceptualized as allocated into a domain that could be called the "domain of suggestibility" (Gheorghiu, 2000). Suggestions are processes that lead persons to respond in an intended direction, as in action or in belief¹. The domain can briefly be characterized as the attempt to define a general framework for analyzing theories on suggestions, suggestive situations, differences concerning individual suggestibility and the application of suggestions. Gheorghiu, Molz and Pohl (2004 p. 418) state the thesis that all of the *different islands* representing single processes, heuristics and biases known in cognitive psychology are likely to be in the *same ocean*. In other words: Most researchers—and we, in this chapter—have concentrated on single phenomena and not on the common framework. Maybe the unpleasant issue of terrorism delivers, because of its ubiquitousness, the possibility of beginning to

¹ At this point we point out to the excellent books of Cialdini (e.g., 2001).

establish such a common framework. In many articles the words “more research has to be done” is a simple phrase. As for our chapter, these words are a challenging not a first but early call to start research that is orientated empirically as well as integratively.

REFERENCES

- Carmichael, L., Hogan, H.P., and Walter, A.A.(1932). An experimental study of the effect of language on the reproduction of visually perceived forms. *Journal of Experimental Psychology*, 15, 73-86.
- Christianson, S.A. (1989). Flashbulb memories: Special, but not so special. *Memory and Cognition*, 17, 435-443.
- Cialdini, R. B. (2001). *Influence: Science and practice (4th ed.)*. Boston: Allyn and Bacon.
- Conway, M.A., Anderson, S.J., Larsen, S.F., Donnelly, C.M., Mc Daniel, M.A., McClelland, A.G.R. et al. (1994). The function of flashbulb memories. *Memory and Cognition*, 22, 326-343
- Davis, J. M. (2003). *Artyrs: Innocence, Vengeance and Despair in the Middle East*. Basingstoke: Palgrave Macmillan.
- Dusenbury, R. and Fenneam, M.G. (1996). Linguistic-numeric presentation mode effects on risky option preferences. *Organizational behaviour und Human Decsion Processes*, 68(29), 109-122.
- Elster, J. (1989). *Solomonic Judgements: Studies in Limitations of Rationality*. New York: Cambridge University Press.
- Fiedler, K. (2004). Illusory correlation. In R.F.Pohl (Ed.), *Cognitive Illusions: A Handbook on Fallacies and Biases in Thinking, Judgement and Memory* (pp.97 – 114). Hove UK: Psychology Press.
- Gheorghiu, V.A. (2000). The domain of Suggestibility: Attempt to conceptualize suggestional phenomena: 1 Particularities of suggestion. In V. De Pascalis, V.A. Gheorghiu, P.W. Sheehan and I. Kirsch (Eds.) *Suggestion and Suggestibility, Hypnosis International Monographs No. 4* (pp 1-28). Munich:M.E:G.-Stiftung.
- Gheorghiu, V.A., Molz, G. and Pohl, R. (2004). Suggestion and illusion. In R. F. Pohl (Ed.), *Cognitive illusions: A Handbook on Fallacies and Biases in Thinking, Judgement, and Memory* (pp. 399-421). Hove, UK: Psychology Press.
- Hamilton, D.L. and Gifford, R.K. (1976). Illusory Correlation in interpersonal perception: A cognitive basis of stereotypic judgements. *Journal of Experimental Social Psychology*, 12, 392-407.
- Kahneman, D, and Tversky, A. (1979). Prospect Theory: An analysis of decision under risk. *Econometrica*, 47, 263-291.
- Levin, I. P. , Schneider, S. L. and Gaeth, G. L. (1998). All frames are not created equal: A typology and critical analysis of framing effects. *Organizational Behavior and Human Decision Processes*, 76, 149-188.
- Loftus, E. F. and Palmer, J. C. (1974). Reconstruction of automobile destruction. *Journal of Verbal Learning and Verbal Behaviour*, 13, 585-589.
- Neisser,U. and Harsch, N. (1992). Phantom flashbulbs: False recollections of hearing the news about Challenger. In E. Winograd und U. Neisser (Eds.), *Affect and Accuracy in*

- Recall: Studies of "Flashbulb Memories"* (9-31). Cambridge: Cambridge University Press.
- Pohl, R. F. (2004). Effects of labeling. In R. F. Pohl (Ed.), *Cognitive Illusions: A Handbook on Fallacies and Biases in Thinking, Judgement, and Memory* (pp. 327-344). Hove, UK: Psychology Press.
- Quensel, Stephan (1964): *Sozialpsychologische Aspekte der Kriminologie: Handlung, Situation und Persönlichkeit*. Enke: Stuttgart.
- Quensel, S. (1986): Let's abolish theories of crime: Zur latenten Tiefenstruktur unserer Kriminalitätstheorien. In: *Kriminologisches Journal I. Beiheft 1986 S.11-23*
- Reuter, C. (2004). *My Life Is a Weapon: A Modern History of Suicide Bombing*. Princeton: University Press.
- Sainsbury, R. (1971). The "Feature Positive Effect" and Simultaneous Discrimination Learning, *Journal of Experimental Child Psychology*, 11, (3) 347-356.
- Schwartz, M. (1982). Repetition and rated truth value of statements. *American Journal of Psychology*, 95, (3), 393-407.
- Simon, H. A. (1997). *Models of Bounded Rationality, Vol. 3*. Cambridge: MIT Press.
- Stern, J. (2003). *Terror in the Name of God: Why Religious Militants Kill*. New York: Ecco/HarperCollins.
- Talarico, J.M. and Rubin, D.C. (2003). Confidence, not consistency, characterises flashbulb memories. *Psychological Science*, 14, 455-461.
- Thüring, M. and Jungermann, H. (1990). The conjunction fallacy: Causality vs. event probability. *Journal of Behavioral Decision Making*, 3(1), 61-74.
- Tversky, A. and Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science*, 211, 453-458.
- Tversky, A. and Kahneman, D. (1992). Advances in prospect theory: Cumulative representation of uncertainty. *Journal of Risk and Uncertainty*, 5, 297-323.
- Victor, B. (2003). *Army of Roses: Inside the World of Palestinian Women Suicide Bombers*. Rodale Press.
- Vlek, C.A.J. (1999). Socializing nuclear power: confronting "technical arrogance" with "public irrationality". *Nuclear Europe Worldscan*, 1(2), 53-54.
- Wassermann, E.A.; Dorner, W.W.; and Kao, S.F. (1990). Contribution of specific cell information to judgments of interevent contingency. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 16, 509-521.

Chapter 7

ACHIEVING GREATER THEORETICAL SOPHISTICATION IN RESEARCH ON SOCIALLY SUPPORTIVE INTERACTIONS AND HEALTH

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ABSTRACT

Supportive social interactions are believed to be important moderators of the phenomenological experience of stress, and so to benefit individuals by ameliorating negative outcomes. This valorization of social support as universally beneficial to humanity has stimulated an overwhelming research literature in health psychology, which emphasizes several inverse statistical associations between social support and physical disease. As this focus resonates with widely-held cultural assumptions about altruism, the health-positive reputation of social cohesion and mutual supportiveness appears at times to be virtually indisputable.

Guided by this worldview, scientific attention has focused on exploring precisely how socially supportive relationships exert positive impacts. However, despite copious research, several particular aspects of the construct and ecology of social support have been neglected in health psychology literature. As well as lacking a specific definition of “social support”, health-focused research has conspicuously failed to link with the wider social psychology literature and the important paradigms it offers. Individual differences in how recipients might interpret and respond to offers of support are also under-researched. Empirically, health-focused research on social support relies heavily on cross-sectional or laboratory paradigms, which threaten internal and external validity.

We argue that the fundamentally atheoretical nature of health psychology research on socially supportive interactions and relationships weakens its explanatory power. We argue for greater theoretical sophistication in these investigations, and show how the integration of such research with the wider social psychology literature offers a superior

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set of paradigms within which the undoubtedly important impact of social interactions on health can be explicated.

INTRODUCTION

To many people, it appears self-evident that social support—the receipt of assistance from others—is an intrinsically positive experience. The assumption that supportive social interactions produce generalizable benefits has underlain moral codes in virtually all cultures and historical periods and, in bald utilitarian terms, is truistic: after all, a dictionary definition of “support” will inevitably incorporate concepts of gain, assistance, and advantage to the recipient. As social animals, humans require cohesion from one another; and, superficially, the message that social support is a good thing has a universal resonance. However, as psychological agents, humans may well differ in their motivations for offering support to others. While many will conclude that offering help to other people is worthwhile because the happiness of others is an intrinsically worthy objective, others will compute that offering support will increase the likelihood that reciprocal assistance will be available in return if needed in the future. And as virtually all people both provide and receive support across multiple social contacts, such provision motivations are likely also to influence how offers of support are interpreted by recipients.

It might be argued that the range of commonsense motivations for valorizing social support can stem from at least five underlying dispositions. A straightforward *sympathetic thinking* disposition might lead people to encourage the giving of social support because of their own positive experiences of having received social support in the past. They may assume that, because they themselves have benefited from support, others will inevitably benefit from similar support in the future. It can be noted that this reasoning rests on at least two generalizations: from the individual to other people; and from the past to the future. Alternatively, a *morally optimistic* disposition might outsource the sympathetic component of this rationale to religious or ethical mores. With such a disposition, an individual might promote and value social support on the basis of understanding (or computing) it to be intrinsically ethical. However, such interpretations assume that people are internally motivated to ensure that others feel happy independently of considerations of their own welfare, a motivation that itself warrants explication.

A *wishful thinking* disposition might lead an individual to infer tangible product from emotional response. In other words, when contemplating social support, an individual might conclude that because giving support to others produces positive feelings in the provider, he or she becomes reinforced (by these good feelings) to give more social support. Such a disposition might be revealed by popular aphorisms surrounding the assertion that giving help (or a gift, or caregiving assistance) is more fulfilling than receiving it, and of interpretations of research studies linking such attitudes to positive mental and physical health (e.g., Brown, Nesse, Vinokur, and Smith, 2003; Dunn, Aknin, and Norton, 2008). It is notable that the core incentive of such reasoning is the achievement of personal happiness rather than the generation of happiness in others, which, assuming self-preservation to be a universal trans-species impulse, might offer a more parsimonious explanation than those invoking sympathetic or moralistic thinking.

Similarly, a *simplistic utilitarian* disposition might encourage an individual to consider social support as a type of universal resource, which, if produced prolifically, will contribute to the overall enhancement of the environment in which the individual lives. In essence, social support might be seen as synonymous with “doing good”, and the promotion of social support as the creation of “more good in the world”. Once again, such reasoning might be vicarious: a *social learning* disposition might lead people to internalize the view that social support is a universal boon simply because of the extent to which they are exposed to such a view in others. Such an effect might be inferred from research showing that people often make moral decisions automatically without conscious thought, and use cognitive heuristics to reason through ethical dilemmas (Cosmides and Tooby, 2006; Sunstein, 2005).

As well as these somewhat folk-psychology perspectives, the notion that social support is an intrinsically beneficial entity is widely held in formal academic/scientific psychology. As supportive social interaction is commonly held to be of benefit to physical well-being, it is no surprise that social support is most commonly considered within health psychology (and related fields such as behavioral medicine). In perhaps the most widely articulated theory of psychological stress—Lazarus and Folman’s (1984) *transactional model*—social support is hypothesized to increase a recipient’s perceived availability of resources with which to cope with the stressfulness of life. As such, social support is presented as a direct means of reducing stress and, in turn, the risk of stress-related physical illness. In Taylor et al.’s (2000) *tend-and-befriend* theory, social support is invoked as the basis of a fundamental gender difference in psychosomatic stress responses. Hobfoll’s (1989) *conservation of resources* theory considers social support to be the basis of self-esteem, and so a fundamental building block of psychological and physical health.

However, while theoretical work in health psychology might offer multiple ways of considering social support, most empirical research is based on a simple framework of correlational reasoning: namely, that quantitative indices of social support will be positively associated with quantitative indices of good health. Broadly, research in epidemiology, behavioral medicine, and health psychology has suggested that recipients of social support live longer, develop fewer diseases, and recover faster from illness (Cohen, 2004). This notion first began to penetrate the formal health sciences and health psychology literature in the 1980s (e.g., House, Landis, and Umberson, 1988), and since then has become more specified. Epidemiological research has reported social support to be closely associated with rates of aspects of cardiovascular health, including atherosclerosis (Rozanski, Blumenthal, and Kaplan, 1999), myocardial infarction (Hedblad, Östergren, Hanson, and Janzon, 1992), post-infarction recovery (Frasure-Smith et al., 2000), and heart disease mortality (Rosengren, Orth-Gomér, Wedel, and Wilhelmsen, 1993). However, such population-based epidemiological surveys are difficult to interpret: given their cross-sectional nature, it is difficult to establish the direction of causality between good health and functional social relationships (O’Donovan and Hughes, 2006).

In an attempt to elucidate causality, a number of researchers in health psychology have attempted to study social support in laboratory settings, by monitoring physiological (e.g., cardiovascular) activity in participants who receive social support from confederates while performing psychologically stressful tasks. Cardiovascular responses to such stressors are known to be a marker of future disease risk in health persons (Treiber, Kamarck, Schneiderman, Sheffield, Kapuku, and Taylor, 2003). By and large, such laboratory-based experiments have indicated that social support can and do attenuate cardiovascular responses

to stressors, with overall effect sizes across studies for social support of $d = .51$ for diastolic blood pressure (DBP) and of $d = .61$ for systolic blood pressure (SBP; Thorsteinsson and James, 1999). However, the summary statistics distract from the fact that a relatively large subset of studies find no effect for support (up to a third of studies reviewed by Thorsteinsson and James, 1999, for example) or else find that ostensibly positive social interaction has an adverse (i.e., *counter-supportive*) effect on participants (e.g., Allen, Blascovich, Tomaka, and Kelsey, 1991; Roy, Steptoe, and Kirschbaum, 1998).

The degree to which these assumptions of positivity that surround social support result from the accumulation of objective empirical data in scientific research or to the penetration of folk assumptions into the reasoning of behavioral scientists when interpreting such data, itself raises an important psychological question. It is to the basis of this question, the scientific study of social support, that we now turn.

PROBLEMS WITH SOCIAL SUPPORT RESEARCH

Empirical studies examining diverse outcomes of social support within various populations have produced findings that vary enormously in both magnitude and direction. The primary problems that emerge in this literature can be considered in terms of two main categories: theoretical and empirical.

THEORETICAL PROBLEMS IN SOCIAL SUPPORT RESEARCH

With regard to the first set of issues, there has been a failure to incorporate several key considerations into the conceptualization of social support, including social psychology theory, relevant individual difference variables, the effects of negative or stressful interactions, and qualitative differences in social support across types of relationships. Furthermore, the definitional problems that plague the concept of social support have yet to be resolved.

Definition of “Social Support”

A major shortcoming of the scholarly research literature is that it contains no consistently used or consensually agreed definition of social support. While some literature distinguishes between perceived and received support (Wethington and Kessler, 1986), other literature differentiates between instrumental, informational, and emotional support (Cohen, 2004). However, the majority adopts a vague unitary definition of social support as a form of help received from other people: many operational definitions are reduced to quantifications of social integration or network size, or to elementary social interactions contrived to occur in laboratories.

Furthermore, definitions of social support typically lead to circular reasoning, in that social support is defined as a social interaction of benefit to the recipient. For example, Cohen (2004) defines social support as “a social network’s provision of psychological and material

resources *intended to benefit* an individual's ability to cope with stress". However, when one attempts to determine whether support has been provided, both in the context of everyday life and in empirical research, the support provider's *intention to give* support is rarely assessed. For instance, a number of research questionnaires ask participants to recall occasions on which they received social support. Given the weight of popular conceptions surrounding the purpose and benefits of social support, it is likely that participants' recollections will be biased towards occasions when tangibly beneficial social support was received. These are likely to include occasions when the support provider provided support in an inadvertent manner, and to exclude occasions when the provider attempted provide support but did so incompetently. The net result of such circumstances is that researchers end up exploring a tautology: the association between self-reported social support received (i.e., the interactions that produced the noticeable benefits) and self- or other-reported positive outcomes (i.e., the noticeable benefits).

This circularity issue is inherent in many of the theories that are pertinent to socially supportive interactions. For example, in the transactional model of stress, stress is essentially depicted as something that someone perceives as stressful. Social support is viewed as a coping resource in so far as it aids coping with stress; fundamentally, it is a resource that is *perceived* by the person. The transactional model consequently relegates the responsibility for operationalizing stress and support to the participant, rather than accounting for this within the model itself. As social support is so commonly invoked as a buffer against the negative impact of stress, the clarification of pertinent stress theories is warranted, in addition to the elucidation of support itself.

The circularity issue may also extend to how researchers interpret diverse findings. A confirmation bias might lead researchers to weight studies linking support to positive outcomes more favorably than studies suggesting adverse outcomes. Indeed, most social support research appears to be aimed at clarifying the contexts in which it is most useful, rather than at evaluating whether or not it is useful per se. Studies reporting no link or negative outcomes may end up in the file drawer.

Neglect of Social Psychology Paradigms

Theoretically, consideration of some fundamental social psychology paradigms suggests that the focus customarily applied in social support research fails to account for the likely complexity of social support interactions. For instance, *social exchange theory* (Kessler, McLeod, and Wethington, 1985), posits that it is the balance between giving and receiving in personal relationships that generates satisfaction with the relationship. According to this theory, over-benefiting from a supportive relationship violates norms of reciprocity and may lead to a state of dependency, while underbenefited people may feel angry and resentful. Research has upheld the implications of this theory. For instance, Kawachi, Kennedy, and Glass (1999) found that individuals who trusted that people would follow the norms of reciprocity in their close environment were more likely to have good or very good self-rated health than those who did not. This suggests that information garnered from evaluating the levels of support a person receives may be more useful and complete when the levels of support they *provide* are also accounted for.

Social exchange theory also offers a ready framework within which to consider the possibility of negative outcomes of social support. Misguided attempts to provide support, when unwanted, or construed as interfering or unhelpful, may essentially constitute negative social exchange. While the stress literature has examined negative interactions in terms of their impact on health, and negative interactions have been acknowledged as an important aspect of social relationships (Cohen, 2004), there has been no coherent attempt to assess the relationship between negative interactions and social support transactions. Do negative interactions impact on health independently of beneficial social support? Or do social support interactions buffer the effects of negative interactions on independent measures of health, such as cardiovascular reactivity? Essentially, it has yet to be clarified whether social support may be conceptualized as a resource or bank, from which negative interactions withdraw and to which positive interactions add, or as a continuum, whereby transactions may be classified as being of various degrees of benefit. Some studies (e.g., Ratnasingam and Bishop, 2007) incorporate assessments of negative social interactions into the research methodology; however, the theoretical integration of negative interactions into the social support context has not been advanced to a stage where consideration of this issue can easily be accommodated within most research studies.

Esteem-enhancement theory (Batson, 1998) draws attention to the need to consider provider perspectives in social support research. This theory proposes that giving support enhances feelings of competency and usefulness and thus is beneficial to esteem. Caring for others without the expectation of a specific or immediate reward is described as constructive and restorative. In a recent study, Gleason, Iida, Shrout, and Bolger (2008) examined the giving and receiving of emotional support in romantic relationships, and found that receiving support was more beneficial on days when support was also provided by the recipient. The researchers postulate that demonstrating one's efficacy through the provision of support may allow one to accept support from one's partner without experiencing efficacy declines. While the exact mechanisms by which giving support has an effect have yet to be illuminated, current evidence recommends that future research should continue this trend of examining social support from both perspectives.

Individual Differences

Many social support studies (especially those based in laboratory settings) appear to assume that social support operates the same way for everybody. However, several personality and individual difference variables that appear relevant to the consideration of social support have been implicated in the etiology of adverse health (examples include hostility, trait anger, cynicism, defensiveness, social dominance orientation, forgiveness, and trait agency/communion).

In addition to differences across individual persons, there appears to be a number of relevant differences across relationship dimensions. For instance, the source of the support (e.g., friend, romantic partner) has been highlighted in the literature as crucial (Thoits, 1982). However, such qualitative differences in social support across relationships have tended to be overlooked in the literature. It is reasonable to postulate that the dimensions of social support transactions (e.g., nature of support given) will vary across different types of relationships. Despite this, the dimensions of social relationships that moderate the effects of social support

remain unexplored across parental, spousal, sibling, friendship, professional, and care-giving relationships.

In addition, there is diversity within given relationship types. To take romantic relationships as an example, while particular features may be considered universal, such partnerships vary in terms of attachment type, communication style, and a host of other variables that may be relevant to the expression of social support.

Recently, Gleason et al. (2008) have asserted that support may differentially affect individuals according to relationship factors and characteristics, an acknowledgement which may promote the assessment of these variables in support research. However, currently, the literature does not consistently account for these aspects in empirical studies, and would evidently do well to do so where possible.

EMPIRICAL PROBLEMS IN SOCIAL SUPPORT RESEARCH

In addition to the problematic conceptual issues cited above, empirical studies of social support are hampered by a number of common methodological shortcomings. For example, studies are often characterized by restricted sampling populations (for instance, a considerable proportion of studies utilize female college student participants) despite the fact that there appear to be clear gender differences in social support effects (e.g., Väänänen, Buunk, Kivimäki, Pentti, and Vahtera, 2005).

The confounding of social support with well-being is another unresolved issue in the social support research. For instance, many indices of social support are network measures, or measures of social integration. However, healthy participants are presumably more likely to have (a) the opportunity and (b) the inclination to engage in social events. Non-healthy participants may be impeded from participating in social activity by disability or illness concerns, and depressed individuals may withdraw from social activity. Consequently, such individuals may score lower on these measures of social support, however, the assumption of a cause and effect relationship between support and health is inaccurate. Failure to control for this consideration results in cause-and-effect conclusions being drawn from what is essentially correlational data.

Social support findings also tend to rely heavily on cross-sectional data, and given the potential importance of a person's history of supportive interactions, it is unlikely that this data can adequately isolate the effects of specific support transactions. Laboratory-based studies may also be contaminated by social facilitation or evaluation anxiety effects that render generalization to real-world situations problematic, though not unfeasible. According to the *drive theory* of social facilitation (Zajonc, 1965), the mere presence of another person during a task induces arousal, something which is neglected in many laboratory studies of social support. Laboratory studies of social support often involve having the participant engage in a cognitive stress task while a confederate or friend provides support of one type or another (e.g., verbal encouragement). The arousal induced by that actual presence of a person however may confuse conclusions about reactivity owing to the stressfulness of the task, and obscure the extent to which the *supportive* presence of the person has an effect on physiological or cardiovascular reactivity. Controls have been implemented in some studies to address these issues that would improve the reliability of findings if applied as a matter of

general practice. By including a non-supportive “mere presence” condition, differences in reactivity can definitively be attributed to the support manipulation of the study rather than to the presence of the confederate.

As such, it should perhaps be no surprise to find that, as described earlier, the findings of the literature on social support and physical health are somewhat equivocal. Epidemiological studies are limited in their ability to control extraneous variables, while laboratory studies linking support to blood pressure report a high number of null effects. However, a number of other research literatures exist which may supplement that found in health psychology in elucidating the impact of socially provided assistance. For example, the empirical study of psychotherapy suggests that the most important facet of therapy may be the recipient’s social contact with a helpful person. One meta-analysis of psychotherapies (Wampold, Mondin, Moody, Stich, Benson, and Ahn, 1997) found that the mean difference in outcomes across all possible comparison of psychotherapy treatment modalities was zero. In other words, the researchers could find no effect attributable to specific paradigmatic elements of various psychotherapies (e.g., their behaviorist, psychoanalytic, cognitive, or humanistic elements): all types of therapy proved to be more or less as effective as all others. These results appear to suggest a generalized treatment effect, in that psychotherapy clients benefit from the act of receiving a treatment (the one element common to all psychotherapies) with the specific content of therapy contributing little or nothing to the outcome. Such an effect that may hint at the nonspecific benefits of socially provided support more effectively than the standard research literature within health psychology.

CONCLUSION

Social support has proved a vastly popular topic in the behavioral sciences, and in particular in health psychology. However, we argue that much of the scientific knowledge base on social support accumulated by academic health psychology suffers from both theoretical and empirical problems. Theoretically, the construct remains poorly defined (with commentators prone to circularity) in the health psychology literature, and hypotheses are based on simplistic models unrelated to any of the highly pertinent conceptual paradigms offered by mainstream social psychology. Further, health psychology largely seems to assume that all individuals will respond identically to socially supportive intervention. Empirically, health psychology researchers struggle to infer causality in relationships between support variables and health outcomes, and face barriers with generalizing findings from clinical samples to the population at large or from laboratory settings to everyday life. In summary, social support as it is studied in health psychology has apparent face validity, but poor construct, internal, and external validity.

We submit that the fundamentally atheoretical nature of health psychology research on socially supportive interactions and relationships weakens its explanatory power. We suggest that research on social support would benefit from greater theoretical sophistication, especially with regard to its integration with the wider literature in social psychology. For example, consideration of social exchange dynamics will undoubtedly assist investigators in hypothesizing more accurately on how best to offer social support to a debilitated person, given the potentially deleterious consequences of drawing attention to the recipient’s

weakness or of producing feelings of indebtedness. Similarly, the impact of social comparisons on feelings of well-being in, say, a peer-support group for recovering cardiac patients may be unexpectedly adverse. We also argue for greater consideration of personality and individual difference variables that influence people's receptiveness to social support. Attempting to build an understanding of social support by assuming it to operate identically in healthy and in clinical groups is conspicuously suboptimal; we submit that health psychology researchers' persistence in doing so is stimulated, at least in part, by a paradigmatic blinkeredness that itself stems from the assumption that social support is simply "a good thing".

In terms of empirical issues, some problems of poor construct validity might be avoided by focusing on objectively verifiable indices of well-being in healthy participants. By measuring biomarkers of disease risk in healthy populations (as opposed to markers of disease status in clinical samples), for example, researchers can be reasonably assured that their data are not confounded by the participants' own attitudes to, or awareness of, a disease. If research shows healthy people's social support to be associated with enhanced immunocompetence or lower blood pressure, it is highly unlikely that this results from biased questionnaire responding or from reverse causality.

It is undoubtedly the case that social interaction offers the potential to enhance people's lives. In virtually all cases, it can do so to a greater extent than any material product. In the domain of health and well-being, social support is a fundamental element of all medical intervention and may even be considered the cheapest form of medicine. As such, it is important that behavioral scientists continue to investigate the ways in which social interaction impacts on physical health. In this regard, the optimization of scholarly treatments of social support should be placed high on the agenda of health psychologists as they proceed into the 21st century.

REFERENCES

- Allen, K. M., Blascovich, J., Tomaka, J., and Kelsey, R. M. (1991). Presence of human friends and pet dogs as moderators of autonomic responses to stress in women. *Journal of Personality and Social Psychology*, *61*, 582-589.
- Batson, C. D. (1998). Altruism and pro-social behaviour. In D. T. Gilbert, S. T. Fiske, and G. Lindzey (Eds.). *The handbook of social psychology* (282-316). Boston, MA: McGraw-Hill.
- Brown, S. L., Nesse, R., Vinokur, A. D., and Smith, D. M. (2003). Providing social support may be more beneficial than receiving it: Results from a prospective study of mortality. *Psychological Science*, *14*, 320-327.
- Cohen, S. (2004). Social relationships and health. *American Psychologist*, *Nov.*, 676-684.
- Cosmides, L., and Tooby, J. (2006). Evolutionary psychology, moral heuristics, and the law. In G. Gigerenzer and C. Engel (Eds), *Heuristics and the law* (pp. 175-205). Cambridge, Massachusetts: MIT Press.
- Dunn, E. W., Aknin, L. B., Norton, M. I. (2008). Spending money on others promotes happiness. *Science*, *319*, 1687-1688.

- Frasure-Smith, N., Lespérance, F., Gravel, G., Masson, A., Juneau, M., Talajic, M., et al. (2000). Social support, depression, and mortality during the first year after myocardial infarction. *Circulation*, *101*, 1919-1924.
- Gleason, M. E. J., Iida M. Shrout, P. E., and Bolger, N. (2008). Receiving support as a mixed blessing: Evidence for dual effects of support on psychological outcomes. *Journal of Social and Personality Psychology*, *94*(5), 824-838.
- Hedblad, B., Östergren, P-O., Hanson, B. S., and Janzon, L. (1992). Influence of social support on cardiac event rate in men with ischaemic type ST segment depression during ambulatory 24-h long-term recording: The prospective population study "Men born in 1914", Malmö, Sweden. *European Heart Journal*, *13*, 433-439.
- Hobfoll, S. E. (1989). Conservation of resources: A new attempt at conceptualizing stress. *American Psychologist*, *44*, 513-524.
- House, J., Landis, S. A., Umberson, D. (1988). Social relationships and health. *Science*, *241*, 540-545.
- Kawachi, I., Kennedy, B. P., and Glass, R. (1999). Social capital and self-rated health: a contextual analysis. *American Journal of Public Health*, *89*(8), 1187-1193
- Kessler, R. C., McLeod, J. D., and Wethington, E. (1985). The costs of caring: A perspective on the relationship between sex and psychological distress. In I. G. Sarason, and B. R. Sarason (Eds.), *Social support: Theory, research and applications* (491-496). Dordrecht: Martinus Nijhoff.
- Lazarus, R. S., and Folkman, S. (1984). *Stress, appraisal, and coping*. New York: Springer.
- O'Donovan, A., and Hughes, B. M. (2006). Your best interests at heart? *Psychologist*, *19*, 216-219.
- Ratnasingam, P., and Bishop, G. D. (2007). Social support schemas, trait anger, and cardiovascular responses. *International Journal of Psychophysiology*, *63*(3), 308-316.
- Rosengren, A., Hawken, S., Ôunpuu, S., Sliwa, K., Zubaid, M., Alhahmeed, W. A., et al. (2004). Association of psychosocial risk factors with risk of acute myocardial infarction in 11 119 cases and 13 648 controls from 52 countries (the INTERHEART study): Case-control study. *Lancet*, *364*, 953-962.
- Rozanski, A., Blumenthal, J. A., and Kaplan, J. (1999). Impact of psychological factors on the pathogenesis of cardiovascular disease and implications for therapy. *Circulation*, *99*, 2192-2217.
- Roy, M. P., Steptoe, A., and Kirschbaum, C. (1998). Life events and social support as moderators of individual differences in cardiovascular and cortisol reactivity. *Journal of Personality and Social Psychology*, *75*, 1273-1281.
- Sunstein, C. R. (2005). Moral heuristics. *Behavioral and Brain Sciences*, *28*, 531-573.
- Taylor, S. E., Klein, L. C., Lewis, B. P., Gruenewald, T. L., Gurung, R. A. R., and Updegraff, J. A. (2000). Biobehavioral responses to stress in females: Tend-and-befriend, not fight-or-flight. *Psychological Review*, *107*, 411-429.
- Thoits, P.A. (1982). Conceptual, methodological, and theoretical problems in studying social support as a buffer against life stress. *Journal of Health and Social Behavior*, *23*(2), 145-159.
- Thorsteinsson, E. B., James, J. E., and Gregg, M. E. (1998). Effects of video-relayed social support on hemodynamic reactivity and salivary cortisol during laboratory-based behavioral challenge. *Health Psychology*, *17*, 436-444.

- Treiber, F. A., Kamarck, T., Schneiderman, N., Sheffield, D., Kapuku, G., and Taylor, T. (2003). Cardiovascular reactivity and development of preclinical and clinical disease states. *Psychosomatic Medicine*, *65*, 46-62.
- Wampold, B.E., Mondin, G.W., Moody, A., Stich, F., Benson, K., and Ahn, H. (1997). A meta-analysis of outcome studies comparing bona fide psychotherapies: Empirically, "all must have prizes". *Psychological Bulletin*, *122*, 203-215.
- Wethington, E., and Kessler, R.C. (1986). Perceived support, received support, and adjustment to stressful life events. *Journal of Health and Social Behavior*, *27*, 78-89.
- Zajonc, R. B. (1965). Social facilitation. *Science*, *149*, 269-274.

Chapter 8

SHOALING BEHAVIOR IN FISH

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ABSTRACT

Social aggregations of fish, termed shoals, are demonstrated by many species and provide individuals with a number of benefits including enhanced access to food and mates, and increased protection from predators. For shoaling fish to reduce predation risk they must choose to aggregate with phenotypically similar fish. In a phenomenon, referred to as the 'confusion effect,' predators have difficulty singling out a specific individual amongst a shoal of similar fish and hesitate momentarily, increasing the opportunity of escape by fish in the shoal. In a related phenomenon known as the 'odddity effect,' phenotypically distinct individuals within a shoal are more likely to be targeted by a predator. It is, therefore, not surprising that fish appear to identify specific phenotypic characteristics and actively choose to associate with fish bearing physical traits similar to their own. Shoal mate choice is also affected by experience. In a series of studies, fish demonstrated shoaling preferences for fish similar to those with whom they had been reared even when those choices would violate the basic premises of the confusion effect. Such results show the effects of learning on shoaling behavior.

In this chapter we provide a review of literature pertaining to shoaling behavior in fish. This review includes analyses of the benefits and costs of shoaling along with an examination of the effects of gender, body size, body coloration, body pattern, familiarity, shoal size, parasite load, and species composition on shoal mate choice. We also review current literature on the effects of experience on shoaling choices and provide a new, previously unpublished study detailing the interplay between body coloration, shoal size, and body size on shoaling behavior.

SOCIAL GROUPINGS IN FISH: SCHOOLS AND SHOALS

Fish may be found as solitary individuals or as members of social groups. Two different types of social groups are schools and shoals. Although the two terms have been used

interchangeably, there is a distinct difference between the two. Schools are relatively complex social organizations. Within a school the fish are oriented in very specific patterns and swim together in a synchronized and polarized fashion [Pitcher 1983]. Fish in schools tend to keep a constant distance between individuals (known as the nearest neighbor distance), and turn, stop, and start in almost perfect unison [Castro and Huber 2003].

Shoaling, on the other hand, is the term used to refer to any loose social aggregation of fish. Fish within a shoal may be randomly distributed and exhibit variable nearest neighbor distances. Shoals are dynamic in nature, with fish commonly joining and leaving the group.

Any group of fish is considered a shoal, but not all shoals demonstrate schooling properties. Fish are also not confined to one type of grouping at the expense of the other. Members of a single species, such as the mackerel (*Scomber scombrus*) or sand-eel (Ammodytidae), may associate in both types of groups during their lives [Pitcher *et al.* 1982b; Pitcher and Wyche 1983]. Fish that are even considered nonsocial may be capable of shoaling and demonstrate some shoaling characteristics in the wild. Studies have shown that the Siamese fighting fish (*Betta splendens*), a highly aggressive, nonsocial fish, will display social preferences within the laboratory and make decisions based on factors known to influence shoal mate choice, indicating the ability to shoal [Snekser, *et al.* 2006; Blakeslee *et al.* 2009a].

THE STUDY OF SHOALING

Shoaling behaviors have been investigated in both freshwater and marine fish. Since shoaling is any aggregation of fish, the groups formed can vary in size, time, and composition. Fish are able to choose whether or not to shoal, who to shoal with, and when to leave the shoal. Researchers state that in many cases the assessment of shoal suitability takes place within a very short time span, probably less than a few seconds [Krause *et al.* 1996; Krause *et al.* 2000b]. Therefore, shoal mate choice can be performed relatively quickly. In addition, because of the tremendous diversity within the fish world in terms of taxonomy, morphology, physiology, ecology, and behavior, comparative studies can be performed within a single species (intraspecific analysis) or between distinctly different species (interspecific analysis) [Godin 1997].

The study of shoaling behavior within the laboratory is relatively easy using dichotomous choice tests [see McRobert 2004]. An aquarium can be split into three chambers through the insertion of two panes of glass. Once the center chamber is isolated from the two end chambers, a stimulus can be added to one or both end chambers and choice sections can be created within the center chamber (see Fig I). The stimuli in the end chambers may be composed of groups of fish or any other factor that may potentially influence association preferences in a test fish, held within the central chamber. Choice sections refer to the space within the center chamber where the test fish is considered to be associating with the end chambers.

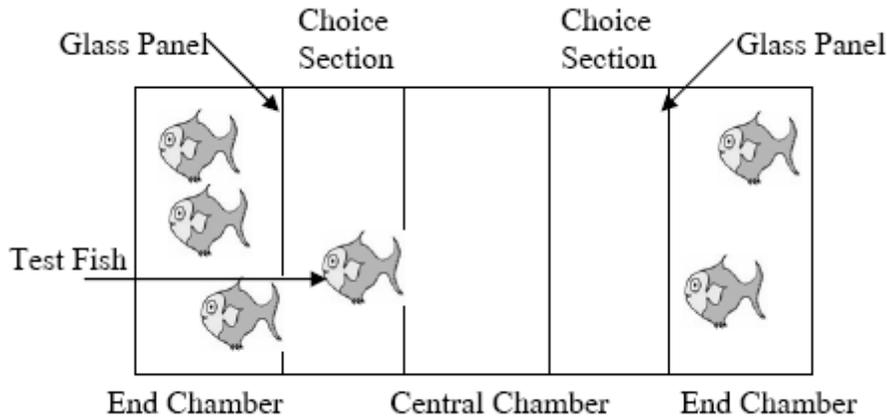


Figure I. A diagram of a test tank used to test shoaling preferences.

During an experiment, an individual test fish is added to the central chamber and given time to acclimate and explore. After this period the experiment begins. During the experiment (typically 600 sec), the time the test fish spends in each of the choice sections, near the end chambers, is measured. Increased time near a particular end chamber indicates a preference for the stimulus within that chamber. Using this method, a variety of questions can be posed about fish's preferences for certain characteristics of stimulus shoals. Examples of characteristics that may influence shoaling include the body length, body coloration, or species composition of fish in the end chambers as well as the number of fish (shoal size) within the end chambers.

Video techniques have also been utilized for studying shoaling behavior within the laboratory. Using video techniques, researchers have been able to manipulate the appearance of normal fish [McCann *et al.* 1971], present various visual patterns [Rosenthal and Ryan 2005], and create shoaling animations [Tobler *et al.* 2006]. Rosenthal [2000] explains that imaged-based approaches are simple to apply and are able to preserve fine spatiotemporal detail while synthetic stimuli are needed when large numbers of manipulations are used in order to preserve the population characteristics.

Studying intact shoals in the wild is a little more complex. The primary goal is to collect intact shoals without losing any members of the group. To accomplish this, some researchers have used beach seines for wild shoal collection [Wagner 1999; Hoare *et al.* 2000; Krause *et al.* 1996]. In this method, shoals are located visually and encircled by the net. This method is ideal for shallow, clear water where one can clearly see the shoal and account for all its members. In the event that one or more fish escape, the shoal is not used for analyses. In deeper, less visible water, researchers have used umbrella nets [Blakeslee *et al.* 2009b], and flume nets [Rozas *et al.* 1988; McIvor and Odum 1986] in which intact shoals are collected instantaneously, although fish on the periphery of the shoal are at risk of being excluded from the sample. Grid-nets have also been used for collection where the two-dimensional positions of the individual fish within the shoals were maintained for detailed analysis of positioning [Ward *et al.* 2002]. Once a shoal is collected from the wild, their composition can be studied in detail in the laboratory.

Although many studies on group choice in animals have been conducted, the exact mechanisms by which fish choose shoal mates remain unknown. Several possible theoretical models exist to explain the mechanisms underlying group formation and maintenance [Pulliam and Caraco 1984; Pitcher and Parrish 1993]. Peichel [2004] acknowledged that shoaling behavior in fish is an excellent system for testing such models since all the mechanisms controlling formation and separation in shoals are not fully understood. One current theory states that whether an individual joins, stays with, or leaves a social group will depend on reassessment of the costs and benefits associated with that group [Pitcher 1986].

BENEFITS AND COSTS OF SHOALING

Within any social group, there are both costs and benefits to grouping. The many benefits include protection from, and detection of, predators, increased opportunity for food acquisition, and facilitated reproduction [Bond 1996]. Each of these benefits ultimately leads to increased fitness. Costs associated with grouping include competition for resources, aggression between group members, easier detection by both predators and potential prey, and increased likelihood of disease and parasite transmission [Bond 1996; Krause and Ruxton 2002; Ritz 1991]. In theory, it is only when the benefits outweigh the costs that it is likely for fish to join social groups.

Food Acquisition

The need to locate food sources is a major concern for any species. Animals in groups may have better foraging success than solitary animals through information sharing and cooperative hunting [Drickamer *et al.* 2002]. Food sources for fish are often patchy and searching for these sources can be energetically costly as well as put the fish at risk for predation. Larger groups of fish have a greater chance of finding food than a solitary fish and information about food sources can be shared more quickly. Because of this, larger shoals gain more benefits for food acquisition than smaller shoals. Such benefits maybe part of the reason why fish are more likely to join larger shoals over smaller shoals [see McRobert 2004].

Street and Hart [1985] found that increasing a group of stoneloach (*Noemacheilus barbatulus*) from one to five individuals resulted in locating a concealed food resource faster. They explained that this was achieved by an increase in the aggregate food detection capability of the group and a reduction in travel time of the group.

Another study looking at foraging, timidity, and shoal size in minnows (*Phoxinus phoxinus*) and goldfish (*Carassius auratus*) also demonstrated the benefits of food acquisition in groups. The results showed that small shoals displayed more timid behavior, such as lurking in weeds or rapid darting and turning, whereas larger shoals made more frequent and lengthy visits to the food patch [Magurran and Pitcher 1983].

Grouping based on foraging benefits appears to have a strong influence on the shoal mate choices of fish. Studies have found that individual fish are able to distinguish between groups of well-fed fish and food-deprived fish. Food-deprived zebrafish, *Danio rerio*, showed a

significant preference for well-fed stimulus fish over food-deprived ones. Well-fed zebrafish did not exhibit any preference for either well-fed or food-deprived stimulus fish [Krause *et al.* 1999]. The authors provided two possible explanations for the preference of food-deprived test fish for well-fed conspecifics: one being reduced competition from well-fed shoal mates and the second being a greater potential food-finding ability of well-fed shoal mates.

However, foraging in groups is not always beneficial for an individual fish. Many studies have shown that once a group's numbers become too large for the resources available, individuals may leave the group to avoid competition for resources [Rita and Ranta 1999]. Hungry three-spined sticklebacks (*Gasterosteus aculeatus*) and well-fed sticklebacks were given a choice between a shoal of conspecifics and an empty compartment as well as two different sized shoals of conspecifics in order to compare the shoal choice of hungry and well-fed fish. It was found that as the duration of food deprivation increased, the amount of time spent near compartments with large shoals of fish decreased [Krause 1993a].

Reproduction/Mate Choice

Solitary individuals may spend lots of time and energy finding and securing mates for sexual reproduction. Individuals who live in groups may be able to find sexual partners more quickly while using less energy [Drickamer *et al.* 2002]. Not only is it easier to find mates within large groups, but individuals can be more selective in their choice of sexual partners. Fish in shoals are provided with the opportunity to assess the quality of their mate in terms of size, color, and other behavioral displays [Dosen and Montgomerie 2004; Amundsen and Forsgren 2001]. Female guppies (*Poecilia reticulata*), for instance, prefer larger-bodied males as mates. The offspring of the larger bodied males sired sons and daughters with higher growth rates [Reynolds and Gross 1992].

In some populations, an individual fish's mating choice may be based on the decisions of other individuals [Brooks 1999]. Such species would benefit from shoaling because they would have a greater chance of observing females choosing males when living in a group as opposed to being solitary. One example of mate choice copying was found in female guppies, *P. reticulata*, where females copied the mate choice of other, usually larger, females [Dugatkin 1992].

There are also costs to reproduction and mate choice associated with grouping in fish. High density shoaling may lead to increased sexual harassment, which can lead to lower food intake by females ultimately reducing their fitness [Magurran and Seghers 1994]. Magurran and Seghers [1994] defined sexual harassment in female fish as the fitness costs females experience as a consequence of persistent male courtship. Wild female Trinidadian guppy (*P. reticulata*) populations are frequently targets of sneaky mating attempts by males. When in groups of manipulated sex ratio, where males outnumbered the females, researchers found a significant decrease in foraging within the females, which could have serious fitness consequences [Magurran and Seghers 1994].

Predation Risk

Protection against predators is one of the most extensively documented selective advantages for fish living in groups [Drickamer *et al.* 2002]. Solitary fish are more likely to be captured by predators than individuals in a shoal [Godin 1986]. There are four proposed mechanisms that make group living safer than solitary living. These include dilution of attack, early predator detection, predator evasion tactics, and predator confusion.

The dilution of attack refers to the idea that as a group size increases, the probability that any individual within the group will be the one attacked, on any single encounter with the predator, decreases [Foster and Treherne 1981]. This is also known as the dilution effect. For instance, in a shoal of 100 fish, an individual has a 1 in 100 chance of being killed during an attack [see McRobert 2004]. Additional benefits from the dilution effect can occur from the increasing individuals who survive the attack gaining knowledge about the attacking predators. Such knowledge could aid individuals in cooperative shoal escape maneuvers on subsequent attacks [Pitcher 1986].

It is difficult to support the dilution effect scientifically because its effects may be confounded by other factors, such as predator confusion. However, some research has been conducted supporting the dilution effect. The attack rate of white perch (*Morone americana*) on individual banded killifish (*Fundulus diaphanus*) in the laboratory was found to be an inverse function of killifish shoal size [Morgan and Godin 1985] matching the expected relationship for the dilution effect.

Early detection of a predator by a group may serve as another benefit of shoaling. Once an individual detects a predator, that information may be shared with other group members [Krause 1993b]. Research has shown that larger shoals of minnows (*P. phoxinus*) detected an approaching predator model sooner than smaller shoals [Magurran *et al.* 1985].

The detection within a group does not necessarily need to be based on visual cues and it can be learned. Mathis *et al.* [1996] showed that predator-naïve flathead minnows (*Pimphales promelas*) gave fright responses to predatory chemical stimulus only when in the presence of predator-experienced minnows and not when in the presence of predator-naïve minnows. Later when presented with the predatory chemical stimulus again, but this time in the absence of any other minnows, the test fish displayed the fright response. This period suggests that individuals benefit from being in groups with predator-experienced members and that they learn from such individuals.

Predator evasion tactics within groups provide protection against predators and therefore adds to the benefits of group living. One tactic that has been well studied is known as the Trafalgar effect. This refers to the process by which an entire shoal receives information from the fish at the periphery of the shoal who detect the predator first [Godin 1986]. For example, the Trafalgar effect was shown in banded killifish (*F. diaphanus*) after being “attacked” by a predator model. The shoaling fish initiated evasive behavior before the approaching predator was detected by all the individuals within the shoal [Godin and Morgan 1985].

The final mechanism, and one of the most influential, making group living safer than solitary living is known as the confusion effect. The confusion effect is defined as the reduced capture efficiency experienced by a predator faced with high densities of prey [Drickamer *et al.* 2002]. Both the number and density of the prey, in addition to the uniformity of appearance of the prey, can enhance the confusion effect [Milinski 1979].

The confusion effect should be maximized when all members of the shoal appear phenotypically similar to one another. It is thought that a predator has difficulty singling out and attacking a specific individual within such a homogenous shoal. Conversely, an odd looking individual within a shoal can increase the success rate for predators with the odd individual being preferentially attacked [Landeau and Terborgh 1986; Theodorakis 1989]. This phenomenon, known as the oddity effect, occurs when an oddly colored, sized, or shaped individual joins an otherwise homogenous shoal. Therefore it is not surprising that fish typically choose shoal mates who are phenotypically similar to themselves [Allan and Pitcher 1986]. This behavior, theoretically, should enhance the confusion effect and reduce the possibility of the oddity effect.

The benefits of the confusion effect are also strongly influenced by shoal size. As the shoal size increases, the benefits of the confusion effect also increase. For a variety of aquatic predators, hunting efficiencies decreased as the size of their prey shoals increased. This may be due to the predator constantly switching targets leading to lengthier and more numerous attacks before successful catches occur [Neill and Cullen 1974]. For example, individual jacks (*Caranx ignobilis*) were more efficient in capturing solitary anchovies (*Stolephorus purpureus*) than in capturing schooling anchovies in marine net enclosures [Major 1978]. Therefore, as with foraging success, the benefits associated with predator protection are usually maximized in larger shoals compared to smaller shoals. These combined benefits indeed may be the reason why fish generally choose larger shoal over smaller shoals.

Finally, researchers have also proposed some disadvantages to schooling and shoaling in terms of anti-predatory defense. Some predators appear to herd groups of fish, causing them to become visible to other predators or leading the fish directly in the path of other predators [Pitcher 1986]. In such situations, fish in a group may actually be easier to capture. Another potential problem with shoaling was detailed in Magurran [1990], who suggested that predators who use olfactory and tactile cues in addition to vision might actually be able to detect prey in large groups more easily than solitary prey.

Increased Transmission of Disease and Parasites

An important risk associated with group living is the increased possibility of disease and parasite transfer between individuals, a risk that obviously is greater for individuals within groups as opposed to solitary individuals. When given the choice between infected and uninfected three-spined sticklebacks (*G. aculeatus*), a test stickleback, regardless of infection, will choose to shoal with the uninfected group when shoal sizes are equal [Barber *et al.* 1998].

SHOAL MATE CHOICE

As mentioned above, many factors influence a fish's decision to shoal. When the benefits outweigh the costs, fish tend to form shoals. Just as fish appear to be able to choose whether or not they shoal, they also appear to actively choose the fish with which they shoal, often maximizing the benefits and minimizing the cost associated with shoaling.

Joining the “correct” shoal is critical for a fish. Many factors, including body coloration/pattern, shoal size, species composition, body length, parasite presence, gender, and familiarity, have been shown to affect shoal mate choice. Other factors not as well studied, such as UV light, luminescence, competitive ability, and background coloration, have also been shown to influence shoal mate choice. Recent studies have also revealed that shoal mate choice in fish develops through a combination of innate and learned behaviors [Engeszer *et al* 2004; Ledesma and McRobert 2007; Ledesma and McRobert 2008].

Shoal Size

In most experimental settings, researchers have found that fish choose the larger shoal when presented with two groups of different size [Magurran and Pitcher 1983; Magurran *et al.* 1985; Krause and Ruxton 2002]. As described above, larger shoal size leads to the benefits of greater foraging efficiency, increased anti-predator tactics, and a greater chance of finding a mate. On the other hand, if resources become limited, a larger shoal can lead to increased competition for resources.

Both minnows (*P. phoxinus*) and goldfish (*C. auratus*) found food faster in larger groups compared to smaller groups [Pitcher *et al.* 1982]. Minnows that were presented with a series of two shoal sizes showed a preference for the larger shoal whenever preference was shown. These shoal decisions occurred more quickly and resulted in a stronger avoidance of smaller shoals when the test fish were in the presence of a predator [Hager and Helfman 1991].

As mentioned above however, bigger is not always better. Hoare *et al.* [2004] showed that group size choice in fish was indeed context-dependent. Banded killifish (*F. diaphanus*) shoaled in significantly smaller groups compared to controls when food odors were present. In contrast, when the fish were presented with alarm odors, simulating the presence of a predator, the shoal size was significantly larger than controls. When the food and alarm odors were mixed, the shoal sizes were larger than the controls, but smaller than the alarm odor response alone. Their findings clearly illustrate both the benefits and costs of group size in shoal mate choice.

Gender

Some studies have looked at the differences in shoal mate choice and shoaling in general of male and female fishes. Differences in shoal mate choice between sexes may be affected by courtship behaviors, sexual harassment, and/or mate-choice systems. For example, wild Trinidadian female guppies (*P. reticulata*) preferred to group with familiar females from their natural wild school, while males did not show any preference in grouping [Griffiths and Magurran 1998]. Differences in shoaling preferences were also found between zebrafish (*D. rerio*) sexes. When given the choice to shoal with males or females, zebrafish males preferred to shoal with females while zebrafish females showed no preference between the sexes [Ruhl and McRobert 2005].

Familiarity

Familiarity can play an important role in shoal mate choices. Research indicates that fish have the ability to recognize specific individuals and prefer to shoal with individuals with whom they have previously been housed [see McRobert 2004]. Barber and Ruxton [2000] showed that familiarity within shoal composition remained stable even when three-spined sticklebacks (*G. aculeatus*) were given the opportunity to re-assort freely in a large arena tank. Furthermore, sticklebacks from different familiarity groups associated with familiar conspecifics significantly more than predicted by a random assortment model.

Both olfactory and visual cues are used to discriminate between familiar and unfamiliar individuals, but the exact mechanisms mediating this phenomenon are not known. Choosing familiar fish may reduce aggression and competition while enabling fish to develop cooperative associations for predator avoidance and foraging [see McRobert 2004].

Familiarity can even outweigh species' preferences in some situations. Chub (*Leuciscus cephalus*) test fish preferred familiar fish when given choices between two shoals of its own species; however, when presented with a familiar shoal of heterospecific and an unfamiliar shoal of conspecifics, the chub preferred to shoal with the familiar heterospecific shoal [Ward *et al.* 2003].

Parasite Load

Even the presence or absence of parasitized individuals within a shoal can affect shoal mate choice. Obviously the presence of infected individuals within a shoal increases the risk of infection for all other fish in the shoal. Parasitic infection has the potential to negatively affect the health of the individual as well as negatively alter its normal foraging and predator-prey behaviors [Barber *et al.* 2000].

When presented with parasitized fish, which can be identified by black infection spots on the body, and uninfected fish, banded killifish (*F. diaphanus*) (infected or uninfected) chose to shoal with the uninfected group [Krause and Godin 1996]. A similar study showed that uninfected three-spined sticklebacks (*G. aculeatus*) preferred to shoal with uninfected conspecifics when the shoal sizes were equal. However, researchers found that the preference for uninfected conspecifics could be overridden. When the infected group's size was three-times that of the uninfected group, the test sticklebacks preferred to shoal with the infected group [Barber *et al.* 1998].

Finally, when sticklebacks were given choices between size-matched minnows and groups of infected and uninfected sticklebacks, the test sticklebacks showed preferences for their own species, regardless of the infection status. These results suggest that the risk of being the odd individual within the shoal (oddity effect) outweighed the negative risk of shoaling with parasitized individuals. Such a study highlights the context dependent nature of choosing shoal mates and how factors such as shoal size, species composition, and parasite load can interact.

Homogenous Shoals

Choosing the shoal that maximizes the benefits and minimizes the cost of grouping often results in choosing a shoal where an individual chooses mates that most closely resemble themselves. To blend in, individual fish must continually assess their own appearance and find shoal mates that they resemble. By electing to be near fish of similar appearance, a fish increases the confusion effect (decreasing the risk of predation), reduces negative consequences from the oddity effect, and increases the chance of being near possible mates. Fish increase the phenotypic homogeneity within a shoal by choosing mates that have a similar shape, size, color/pattern, or mates of conspecifics.

Body Shape

Research on the effects of body shape on shoal mate choice is very limited. It is rare to find variation in body shape within a single species, and it is difficult to account for shoaling differences based solely on shape when presenting fish with a different species or sexually dimorphic genders. Nevertheless, in order to create a homogenous shoal it is likely that fish would choose individuals with a similar body shape to their own.

In the zebrafish (*D. rerio*) males and females vary in body shape by 10 percent. When zebrafish were presented with stimuli modeling the body shapes of each sex, females were shown to prefer the male body shape rather than the female body shape [Turnell *et al.* 2003]. Also using *D. rerio*, Snekser and McRobert [2005, unpublished] showed that wild type *D. rerio* preferred groups of similarly shaped pearl danios (*D. albolineatus*) to groups of white skirt tetras (*Gymnocorymbus ternetzi*), which have a dramatically wider body. In this study *D. rerio* individuals were presented with two different species with which to shoal. These species were identical in coloration, which suggest that the shoal mate choice was based primarily on body shape.

Body Size

Many studies have looked at shoaling choices based on body size differences. As expected, fish typically shoal with individuals of a similar size to themselves [Pitcher *et al.* 1986; Krause 1994; Ranata *et al.* 1992]. This is known to occur in the wild as well as in the laboratory. Many free-ranging shoals have found to be assorted not only by species, but also strongly assorted by body length [Croft *et al.* 2003; Hoare *et al.* 2000; Krause *et al.* 2000b]

Body-size segregation seems to occur to a higher degree in the presence of predators. European minnows (*P. phoxinus*) formed more strongly size-assorted shoals under predation attack [Pitcher *et al.* 1986]. Choosing mates of similar body length reduces the oddity effect. A study using shoals with oddly sized individuals resulted in more successful predatory attacks on the shoal [Theodorakis, 1989].

Body length has been shown to have a greater influence than both shoal size and species composition on shoal mate choice in some species of fish. Banded killifish (*F. diaphanus*) preferred to shoal with similarly sized fish irrespective of shoal size and preferred to shoal

with similarly sized fish of a different species rather than conspecifics of a larger size [Krause and Godin 1994].

Choosing mates of a similar body size has also been shown to increase foraging success. Individual three-spined sticklebacks (*G. aculeatus*) in dissimilar body-sized groups, had lower foraging rates than fish in similar body-sized shoals [Peukhuri 1997].

The concept of body size as a factor in shoal mate choice is a strong example of the dynamic nature of shoaling behavior. While factors such as coloration, pattern and, obviously, species, remains constant throughout the lives of most fish, body size is constantly changing. The ability of fish to choose shoal mates of similar size indicates the ability of fish to monitor their own size and make adjustments in their choice of shoal mates.

Body Coloration/Body Pattern

Body coloration and pattern can vary between species and within a single species. For example, many studies looking at the influence of body pattern on shoal mate choice have focused on striping patterns. McCann *et al.* [1971] altered photographs of zebrafish (*D. rerio*) to remove the striping pattern naturally found on the fish. The results showed that zebrafish preferred to shoal with the photographs that had striping patterns rather than those without striping patterns. Using computer animation, Rosenthal and Ryan [2005] also found that *Danios* preferred patterns similar to their own when presented with shoals of various patterns.

Studies analyzing the effects of body coloration are somewhat limited. Mollies (*Poecilia latipinna*) are an example of fish that can vary in color within its own species. Both black and white mollies spent significantly more time with mollies of similar coloration to their own [McRobert and Bradner 1998]. Later studies showed that when given a choice between a smaller group of similar coloration and a larger dissimilar colored group, black and white mollies chose to spend more time with the smaller, similarly colored shoal [Bradner and McRobert 2001b]. Body coloration may in fact override preferences for larger shoal sizes in some species of fish.

Recent studies have looked at the effects of body coloration and pattern and its interaction with shoal size in female Siamese fighting fish (*B. splendens*). Even in this highly aggressive species, both white females and brown-striped females preferred shoals of similar color and pattern to shoals of dissimilar fish. However, unlike the study with black and white mollies, no overriding preference between body coloration and pattern and shoal size was found for this species [Blakeslee *et al.* 2009a].

Species Composition

Typically fish shoal with conspecifics, or fish of the same species. Joining a shoal of conspecifics enhances an individual's chance of finding potential mates, may enhance foraging success since it is likely that members of the same species would have similar dietary preferences, and enhance the confusion effect since fish from the same species are likely to be phenotypically similar [see McRobert 2004]. It has been shown that fish can discriminate between different species using both visual [Magurran *et al.* 1994] and olfactory cues [Brown *et al.* 1993]. Collections of entire free ranging fish shoals have shown that in

many cases, fish were assorted by both species and body length [Krause *et al.* 2000a; Krause *et al.* 1996].

In spite of the benefits from shoaling with conspecifics, not all shoaling in the wild is assorted by species; mixed species shoaling behavior has been observed in both the wild and laboratory [Krause and Godin 1994]. For example, Schlupp and Ryan [1996] showed that while sailfin mollies (*P. latipinna*) and Amazon mollies (*P. Formosa*) preferred to associate with conspecifics, when given the choice between heterospecifics of larger numbers and conspecifics of smaller numbers, both species associated with the larger, heterospecific group.

Other Factors

Many other factors have been shown to influence shoaling decisions in fish, although few studies of these factors are found in the literature. Some of these factors include UV light, luminance, competitive ability, and background color.

The visual system of many fish species extends into the ultraviolet (UV) range, 300-400nm [Losey *et al.* 1999]. Researchers found that three-spined sticklebacks (*G. aculeatus*) preferred groups of other sticklebacks seen through a UV-transmitting filter over groups of other sticklebacks seen through a UV-blocking filter. Researchers also wanted to understand the role of luminance and its interaction with UV light. To do this, control experiments were run with neutral-density optical filters. Stickleback test fish significantly preferred shoals seen in a darker environment [Modarressie *et al.* 2006]. These findings suggest a potential trade-off between UV radiation and lower brightness in shoal mate choice.

A study was conducted assessing the influence of competitive ability on the shoal mate choice of individual fish. Metcalfe and Thompson [1995] showed that European minnows (*P. phoxinus*) preferred to shoal with groups of low competitive ability to shoals containing superior competitors when size and feeding rates were identical in the two shoals. This preference may enable the individual fish to exploit food resources at a greater degree than shoal mates.

Finally, the surrounding external environment can influence shoal mate choice in some fish. Bradner and McRobert [2001] analyzed how background coloration influenced body color segregation and shoal mate choice in mollies (*P. latipinna*). The preferences of black test fish for shoals of black test fish increased when the shoal was presented with a black background over a white background. If test fish were presented with a black shoal swimming against a white background and an empty chamber with a black background, then their preference would shift to the shoal with the white background. When given a choice between two white shoals in either black or white background, black test fish significantly preferred the white shoals in the black background [Bradner and McRobert, 2001]. Findings from this study suggest that background color can alter the shoal mate choice of fish, especially those known to assort by body coloration. This may reflect the potential of anti predator benefits of blending into the background, although this has not been tested in a scenario with predators present.

SHOALING: INNATE BEHAVIOR ENHANCED THROUGH LEARNING

Researchers have recently turned their attention to shoaling in juvenile fish and the fundamental processes underlying shoal mate choice in fish. It is known that juveniles of several species of fish shoal, including roach (*Rutilus rutilus*) [Persson and Eklov, 1995], Pollock (*Pollachius virens*) [Rangeley and Kramer, 1998], guppies (*P. reticulata*) [Ledesma and McRobert 2007], mollies (*P. latipinna*) [Ledesma and McRobert 2008], and zebrafish (*D. rerio*) [Ledesma and McRobert 2007, unpublished].

In an experiment which isolated guppies (*P. latipinna*) within 24 hours of birth found that the basic behavior of shoaling was innate and could be seen in fish as young as 10 days old. However, preferences for fish of similar body size or for larger shoal sizes were not observed until the young guppies reached 50 days old [Ledesma and McRobert, 2007]. Reasons for this delay in preference may be due to sensory developmental delays in the juvenile fish, a lack of early social experiences encountered by the isolated fish, or by a lack of benefits incurred by such choices in very young fish. However, since the isolated fish eventually showed preferences for larger body size and larger shoal size (at 50 days of age) it appears that these decisions are innate. A similar study using isolated 40 days old juvenile zebrafish (*D. rerio*) also found that the basic ability to shoal was innate. Isolated 40 days old juvenile zebrafish were tested for shoal size preferences and spent significantly more time near the larger shoal [Ledesma and McRobert 2007, unpublished]. These results provide additional support for an innate component to shoaling behavior and specific shoal mate preferences.

Further research has shown that while the basic behavior of shoaling is innate for some species, early social experience has a dramatic influence on some shoaling preferences. Wild type zebrafish (*D. rerio*) reared with groups of *nacre* (stripeless) mutant zebrafish significantly preferred the un-striped zebrafish as shoal mates [Engeszer *et al.* 2004; Spence and Smith 2007]. A result atypical of wild type adult zebrafish raised with other wild type zebrafish. The preference for striping pattern in wild type and *nacre* (stripeless) mutant zebrafish therefore appears to be a learned behavior influenced by early social experience.

In a similar fashion, another study found the importance of early social experience on shoaling preferences based on body coloration for juvenile mollies (*P. latipinna*). Black and white juvenile mollies were housed with similarly colored fish or dissimilarly colored fish. Regardless of their own color, mollies demonstrated a significant preference for the body coloration of the fish with which they had been reared [Ledesma and McRobert, 2008]. As with the striping pattern, the preference for shoal mates of similar body coloration also appears to be a learned behavior influenced by early social experience.

SHOALING CASE STUDY

For this chapter, a pilot study was conducted using black and white mollies (*P. latipinna*) to analyze the interplay between the affects of body length, shoal size, body coloration, and the oddity effect on the shoal mate choice in mollies and is included in this chapter. The experimental procedure, results of the study, and an analysis of those results are presented here.

Experimental Procedure

Adult mollies were obtained from Seven Seas Tropical Fish (Philadelphia, PA). Fish of two common color morphs were used: black and white. Fish were separated by color and housed in groups. Water temperature was maintained between 25-27°C and fish were fed tropical fish flakes once per day. On test days, fish were fed following the test.

The experimental procedure for shoaling assays was similar to that used previously in published shoaling research [McRobert and Bradner 1998; Bradner and McRobert 2001a and b; Sneker *et al.* 2006]. Choice tests were performed in tanks that were constructed by dividing aquaria (74 cm x 31 cm x 31 cm) into three chambers. Each end chamber (18 cm x 31 cm x 31 cm) was separated from the central chamber (38 cm x 31 cm x 31 cm) by clear glass partitions sealed with silicone caulk allowing for no passage of odor stimuli between the end and center chambers. The central chamber was then divided into left and right sides, creating choice sections, by the addition of opaque Plexiglas partitions (25 cm x 18 cm). Fish within the central chamber, referred to as “test fish”, were able to swim around these partitions to view either end chamber making decisions based on visual stimuli, but the partitions prevented test fish from viewing both end chambers simultaneously. Green paper was taped around the sides and back of the test tank to reduce possible disturbance to the test fish. Each end chamber contained one box filter and one heater.

Groups of seven stimulus fish were placed into end chambers at least 12 h prior to the start of each choice test. Individual test fish were placed into the central chamber and allowed to acclimate for 1 h prior to testing. Test fish were observed for 600 s and the times spent on either side were recorded. All observations were performed between 08:00 and 16:00 h in June of 2008.

Black mollies and white mollies served as test fish in a series of shoaling assays. To determine shoaling preferences, test fish were exposed to pairs of stimuli as presented in Table I.

Table I. Pairs of stimuli presented to 20 test fish

Test Fish	Stimuli 1	Stimuli 2
Large (5-6.5 cm) White Fish	7 Large (5-6.5 cm) White Fish	7 Small (1-2.5 cm) White Fish
Sized Matched White Fish	7 Sized Matched White Fish	7 Sized Matched Black Fish
Sized Matched Black Fish	7 Sized Matched White Fish	7 Sized Matched Black Fish
Sized Matched White Fish	2 Sized Matched White Fish	7 Sized Matched Black Fish
Sized Matched Black Fish	7 Sized Matched White Fish	2 Sized Matched Black Fish
Sized Matched White Fish	2 Sized Matched White Fish + 5 Sized Matched Black Fish	7 Sized Matched Black Fish
Sized Matched Black Fish	2 Sized Matched White Fish + 5 Sized Matched Black Fish	7 Sized Matched Black Fish

Each test fish was used only once in a single choice tests to avoid pseudo-replication. Stimuli were alternated between the left and right chambers, ten trials each, to reduce the risk of side biases. A total of twenty test fish were used for each choice test. One-sample *t*-tests, compared with a null expectation (0.5 total time or 300 sec) were used to compare the time

spent by the test fish on either side of the central compartment and find significant preferences.

Results

All results are summarized in Table II.

Table II. Mean association times (s) + SE for black and white test fish in response to different stimuli

Test Fish	Stimuli (End Chambers)	Mean Association Time (s) \pm SE
Large (5-6.5 cm) White Fish	7 Large (5-6.5 cm) White Fish	482.05 \pm 35.91
	7 Small (1-2.5 cm) White Fish	122.95 \pm 38.10
White Fish	7 Sized Matched White Fish	558.75 \pm 20.28
	7 Sized Matched Black Fish	41.25 \pm 20.28
Black Fish	7 Sized Matched White Fish	60.30 \pm 32.90
	7 Sized Matched Black Fish	539.70 \pm 32.90
White Fish	2 Sized Matched White Fish	532.05 \pm 36.67
	7 Sized Matched Black Fish	67.95 \pm 36.67
Black Fish	7 Sized Matched White Fish	142.95 \pm 53.31
	2 Sized Matched Black Fish	457.05 \pm 53.31
White Fish	5 Sized Matched Black Fish + 2 Sized Matched White Fish	476.65 \pm 42.98
	7 Sized Matched Black Fish	123.40 \pm 42.98
Black Fish	5 Sized Matched Black Fish + 2 Sized Matched White Fish	87.70 \pm 46.76
	7 Sized Matched Black Fish	512.30 \pm 46.76

When large (5-6.5 cm) white test fish were given the choice between a group of seven small (1-2.5 cm) white fish and seven sized matched white fish, the test fish spent significantly more time near the group of sized matched white fish ($t = 5.070$, $p < 0.000$). White test fish also spent significantly more time near the group of seven sized matched white fish than seven sized matched black fish ($t = 12.759$, $p < 0.000$), while the reverse was true

for black test fish. The black test fish spent significantly more time near seven sized matched black fish rather than seven sized matched white fish ($t = 7.285$; $p < 0.000$). When given the choice between a group of seven sized matched black fish and two sized matched white fish, white test fish spent significantly more time near the group of two white fish ($t = 6.328$, $p < 0.000$). Similarly, when black test fish were given the choice between a group of seven sized matched white fish and two sized matched black fish, they spent significantly more time near the two sized matched black fish ($t = 2.946$, $p < 0.01$). Finally, both black test fish and white test fish were given the choice between seven sized matched black fish and five sized matched black fish in addition to two sized matched white fish. The white test fish spent significantly more time with the group containing two sized matched white fish ($t = 4.110$; $p < 0.01$), while black test fish spent significantly more time near the group only containing sized matched black fish ($t = 4.540$; $p < 0.000$).

Discussion

The study presented in this chapter was built from what is known about the shoaling behavior of mollies, *P. latipinna*. Previous studies using mollies have shown that they prefer groups of conspecifics to empty chambers [Bradner and McRobert 2001a] and that they prefer larger groups of conspecifics over smaller groups of conspecifics when size and body coloration are held constant [Bradner and McRobert, 2001b]. Using this information, questions were asked of the test fish to analyzed how body length, shoal size, body coloration, and the oddity effect influences shoaling decisions in these fish and which factors can override others when choosing to join a particular group.

Large (5-6.5 cm) white test fish were given a choice between groups of seven sized matched white fish and seven smaller (1-2.5 cm) white fish. As one might expect, the large test fish preferred the group of sized matched fish. These findings support a variety of other research showing that fish typically join sized matched fish [Pitcher *et al.* 1986; Krause 1994; Ranata *et al.* 1992]. Such a choice enables the test fish to join a group of morphological similar fish, enhancing the confusion effect and decreasing its chance of being the odd individual within the group.

McRobert and Bradner [1998] determined that black mollies and white mollies preferred groups of four fish with similar body coloration over groups of four fish of dissimilar body coloration. We repeated this test with both black and white mollies increasing the stimuli shoals from four to seven fish. No change in preference was found and black test fish and white test fish still preferred groups of similar body coloration to groups of dissimilar body coloration. These decisions again enabled the test fish to blend in with other members of the group potentially maximizing the benefits associated with decreasing its risk of predation.

Bradner and McRobert [2001b] also found that black mollies and white mollies preferred smaller groups ($n=3$) of similarly colored fish to larger groups ($n=6$) of dissimilarly colored fish, indicating that body coloration has a stronger influence on shoal mate choice than shoal size. This question was repeated increasing the difference in the size of groups to determine if the preference for body coloration over shoal size would be lost or reversed. White test fish and black test fish now had the choice between a group of only two similarly colored fish and a group of seven dissimilarly colored fish. Even with the increased difference in shoal size,

both black test fish and white test fish still significantly preferred the smaller group of fish with similar body coloration to themselves.

Indeed it does appear that body coloration can override shoal size preferences in this species of fish. Although many antipredator benefits increase as shoal size increases, fish joining a shoal containing phenotypically different fish put themselves at risk due to the oddity effect [Landeau and Terborgh 1986; Theodorakis 1989]. Due to the negative consequences of being the odd individual within the group, it is not surprising that the test fish chose the smaller group containing visually similar fish. It is still possible, however, that different patterns of associations may be found with even larger size differences between the shoals. There may be a point at which individuals choose the large shoal of dissimilar colored fish because the benefits from factors such as numerical dilution outweigh the negative consequences of the oddity effect.

Finally, this study attempted to demonstrate the ways in which shoal mate choice may be affected by the oddity effect. Black mollies were tested for preferences between a shoal containing seven sized matched mollies of similar coloration and a shoal containing five sized mollies of similar coloration plus two sized matched mollies of dissimilar coloration. It was found that the black mollies significantly preferred the homogenous black group. In theory, this shoal would have greater benefits from the confusion effect while the other shoal would be at a greater risk of being attacked by a predator due to the presence of odd looking individuals within the group.

In order to look at the other perspective, white mollies were tested to find out if they had the ability to distinguish between a homogenous shoal containing all dissimilar colored fish and a shoal containing mostly dissimilar colored fish, but also containing two similar colored fish. In this situation, the test fish had the choice between a group of fish where if joined, it would become the only odd individual, and a group of fish where if joined, it would have only two similar individuals within the group. Even with only two morphologically similar individuals being present, the white test fish significantly preferred the group containing five black fish with two white fish. The white fish may still be subject to negative affects associated with being the morphologically odd individual with respect to body coloration, but its decision prevented it from being the only odd individual within the group. Such a decision may increase the chances for survival in the event of predation attack.

The results from this study support current literature on the factors affecting shoal mate choice. In all cases presented, test fish preferred groups of phenotypically similar fish, which would ultimately enhance the benefits of the confusion effect while simultaneously decreasing the potential negative consequences of the oddity effect. Results also indicated that test fish have the ability to distinguish between a homogenous shoal and a shoal containing only two dissimilar individuals. Beyond that, the test fish may have demonstrated the complex nature of shoaling and the ability to assess the costs and benefits associated with different groups.

SUMMARY

A shoal is a simple, loose aggregation of fish. Shoaling is beneficial for individual fish through increased foraging success, reduced risk of predation, and increased mating

opportunities. In order to maximize these benefits, fish will often actively choose shoals based off of the characteristics of individuals within the group. These characteristics include body coloration/pattern, shoal size, species composition, body length, parasite presence, gender, and familiarity. Fish often choose shoal mates phenotypically similar in order to gain benefits from the confusion effect and avoid problems associated with the oddity effect. Fish also select familiar shoal mates possibly reducing competition and benefiting from cooperative behavior. It appears that while the basic shoaling behavior of fish is innate, many of the preferences for shoal mates develop due to early social experience and are in fact a learned behavior. The study of shoaling remains an active field of research examining mechanisms underlying the formation of shoals and developing our understanding of shoaling behavior in the wild.

REFERENCES

- Allan, J. and Pitcher, T. (1986). Species segregation during predator evasion in cyprinid fish shoals. *Freshwater Biology*, 16, 653-659.
- Amundsen, T. and Forsgren, E. (2001). Male mate choice selects for female coloration in a fish. *Proceedings of the National Academy of Sciences*, 98, 13155-13160.
- Barber, I. and Ruxton, G. (2000). The importance of stable schooling: do familiar sticklebacks stick together? *Proc. R. Soc. Lond. B.*, 267, 151-155.
- Barber, I., Downey, L. and Braithwaite, V.A. (1998). Parasitism, oddity and the mechanism of shoal choice. *Journal of Fish Biology*, 53, 1365-1368.
- Blakeslee, C.J., McRobert, S.P., Brown, A.C., and Clotfelter, E.D. (2009a). The effect of body coloration and group size on social partner preferences in female fighting fish (*Betta splendens*). *Behavioural Processes*, 80, 157-161.
- Blakeslee, C.J., Ruhl, N., Currie, W., and McRobert, S.P. (2009b). Shoaling preference of two common killifish (*Fundulus heteroclitus* and *F. diaphanous*) in the laboratory and the field: a new analysis of heterospecific shoaling. *Behavioural Processes*, in press.
- Bond, C. (1996). *Biology of Fishes* (2nd Ed.). Crawfordsville, IN: Thomson Learning, Inc.
- Bradner, J. and McRobert, S.P. (2001a). Background coloration influences body colour segregation in mollies. *Journal of Fish Biology*, 57, 673-681.
- Bradner, J. and McRobert, S.P. (2001b). The effect of shoal size on patterns of body colour segregation in mollies. *Journal of Fish Biology*, 59, 960-967.
- Brown, G.E., Brown, J.A. and Crosbie, A.M. (1993). Phenotype matching in juvenile rainbow trout. *Animal Behaviour*, 46, 1223-1225.
- Castro, P. and Huber, M. (2003). *Marine Biology* (4th Ed.). New York: McGraw Hill.
- Croft, D.P., Arrowsmith, G.J., Bielby, J., Skinner, K., White, E., Couzin, I.D., Magurran, A.E., Ramnarine, I. and Krause, J. (2003). Mechanisms underlying shoal composition in the Trinidadian guppy, *Poecilia reticulata*. *Oikos*, 100(3), 429-438.
- Dosen, L.D. and Montgomerie, R. (2004). Female size influences mate preference of male guppies. *Ethology*, 110, 245-255.
- Drickamer, L., Vessey, S. and Jakob, E. (2002). *Animal Behavior* (5th Ed.). New York: McGraw-Hill.

- Dugatkin, L.A. (1992). Sexual selection and imitation: females copy the mate choice of others. *Am. Nat.*, 139, 1384-1489.
- Engeszer, R.E., Ryan, M.J. and Parichy, D.M. (2004). Learned social preference in sebrafish. *Current Biology*, 14(10), 881-884.
- Foster, W. and Treherne, J. (1981). Evidence for the dilution effect in the selfish herd from fish predation on a marine insect. *Nature*, 293, 466-467.
- Godin, J.-G.J. (1986). Antipredator function of shoaling in teleost fishes: a selective review. *Naturaliste can.*, 113, 241-250.
- Godin, J.-G.J. (1997). Behavioural ecology of fishes: Adaptations for survival and reproduction. In: *The Behavioural Ecology of Teleost Fishes* (pp. 1-9). New York: Oxford University Press.
- Godin, J.-G.J. and Morgan, M. (1985). Predator avoidance and school size in a cyprinodontid fish, the banded killifish (*Fundulus diaphanus* Lesueur). *Behav. Ecol. Sociobiol.*, 16, 105-110.
- Griffiths, S. and Magurran, A. (1998). Sex and schooling behaviour in the Trinidadian guppy. *Animal Behaviour*, 56, 689-693.
- Hager, M. and Helfman, G. (1991). Safety in numbers: shoal size choice by minnows under predatory threat. *Behav. Ecol. Sociobiol.*, 29, 271-276.
- Hoare, D.J., Ruxton, G.D., Godin, J.-G.J. and Krause, J. (2000). The social organization of free-ranging fish shoals. *Oikos*, 89, 546-554.
- Hoare, D.J., Couzin, I.D., Godin, J.-G.J. and Krause, J. (2004). Context-dependent group size choice in fish. *Animal Behavior*, 67, 155-164.
- Krause, J. (1993a). The influence of hunger on shoal size choice by three-spined sticklebacks, *Gasterosteus aculeatus*. *Journal of Fish Biology*, 43, 775-780.
- Krause, J. (1993b). Transmission of fright reaction between different species of fish. *Behaviour*, 127, 37-48.
- Krause, J. (1994). The influence of food competition and predation risk on size assortative shoaling in juvenile chub (*Leuciscus cephalus*). *Ethology*, 96, 105-116.
- Krause, J. and Godin, J.-G.J. (1994). Shoal Choice in the Banded Killifish (*Fundulus diaphanus*, Teleostei, Cyprinodontidae): Effects of Predation Risk, Fish Size, Species Composition and Size of Shoals. *Ethology*, 98, 128-136.
- Krause, J. and Godin, J.-G.J. (1996). Influence of parasitism on shoal choice in the banded killifish (*Fundulus diaphanus*, Teleostei, cyprinodontidae). *Ethology*, 102, 40-49.
- Krause, J. and Ruxton, G.D. (2002). *Living in Groups*. New York: Oxford University Press.
- Krause, J., Hoare, D., Croft, D., Lawrence, J., Ward, A., Ruxton, G., Godin, J.-G.J. and James, R. (2000a). Fish shoal composition: mechanisms and constraints. *Proc. R. Soc. Lond. B.*, 56, 1023-1027.
- Krause, J., Butlin, R.K., Peuhkuri, N. and Pritchard V.L. (2000b). The social organization of fish shoals: a test of the predictive power of laboratory experiments for the field. *Biol. Rev.* 75, 477-501.
- Krause, J., Godin, J.-G.J. and Brown, D. (1996). Phenotypic variability within and between fish shoals. *Ecology*, 77(5), 1586-1591.
- Krause, J., Hartmann, N. and Pritchard, V. (1999). The influence of nutritional state on shoal choice in zebrafish, *Danio rerio*. *Animal Behaviour*, 57, 771-775.
- Landeau, L. and Terborgh, J. (1986). Oddity and the 'confusion effect' in predation. *Animal Behaviour*, 34, 1372-1380.

- Ledesma, J.M. and McRobert, S.P. (2007). Shoaling in juvenile guppies: the effects of body size and shoal size. *Behavioural Processes*, 77, 384-388.
- Ledesma, J. and McRobert, S.P. (2008). The role of body coloration and early experience on shoaling behaviour in juvenile mollies, *Poecilia latipinna*. *Ethology*. In press.
- Losey, G.S., Cronin, T.W., Goldsmith, T.H., Hyde, D., Marshall, N.J. and McFarland, W.N. (1999). The UV visual world of fishes: a review. *J. Fish Biol.*, 54, 921-943.
- Magurran, A. (1990). The adaptive significance of schooling as an anti-predator defence in fish. *Ann. Zool. Fennici.*, 27, 51-66.
- Magurran, A., Oulton, W. and Pitcher, T.J. (1985). Vigilant behaviour and shoal size in minnows. *Z. Tierpsychol.*, 67, 167-178.
- Magurran, A.E. and Pitcher, T.J. (1983). Foraging, timidity and shoal size in minnows and goldfish. *Behavioral Ecology and Sociobiology*, 12, 147-152.
- Magurran, A.E. and Segher, B.H. (1994). A cost of sexual harassment in the guppy, *Poecilia reticulata*. *Proceedings: Biological Sciences*, 258(1351), 89-92.
- Magurran, A.E., Seghers, B.H., Shaw, P.W. and Carvalho, G.R. (1994). Schooling preferences for familiar fish in the guppy, *Poecilia reticulata*. *Journal of Fish Biology*, 45, 401-406.
- Major, P. (1978). Predator-prey interactions in two schooling fishes, *Caranx ignobilis* and *Stolephorus purpureus*. *Anim. Behav.*, 26, 760-777.
- Mathis, A., Chivers, D. and Smith, R.J.F. (1996). Cultural transmission of predator recognition in fishes: intraspecific and interspecific learning. *Anim. Behav.*, 51, 185-201.
- McCann, L.I., Kohen, D.J. and Kline, N.J. (1971). The effects of body size and body markings on nonpolarized schooling behavior of zebrafish (*Brachydanio rerio*). *Journal of Psychology*, 79, 71-75.
- McIvor, C.C. and Odum, W.E. (1986). The flume net: a quantitative method for sampling fishes and macrocrustaceans on tidal marsh surfaces. *Estuaries*, 9(3), 219-224.
- McRobert, S.P. (2004). Shoaling behavior in fish. In: M. Bekoff (ed.), *The Encyclopedia of Animal Behavior*. (pp. 1012-1016). Phoenix, AZ: Greenwood Publishing Group.
- McRobert, S.P. and Bradner, J. (1998). The influence of body coloration on shoaling preferences in fish. *Animal Behaviour*, 56, 611-615.
- Millinski, M. (1979). Can an experienced predator overcome the confusion of swarming prey more easily? *Anim. Behav.*, 27, 1122-1126.
- Modarressie, R., Rick, I.P. and Bakker, T.C.M. (2006). UV matters in shoaling decisions. *Proc. R. Soc. B*, 273, 849-854.
- Morgan, M. and Godin, J. (1985). Antipredator benefits of schooling behaviour in a cyprinodontid fish, the banded killifish (*Fundulus diaphanus*). *Z. Tierpsychol.*, 70, 236-246.
- Neill S.R.St.J. and Cullen, J. (1974). Experiments on whether schooling by their prey affects the hunting behaviour of cephalopods and fish predators. *J. Zool. Lond.*, 172, 549-569.
- Peichel, C.L. (2004). Social Behavior: How do fish find their shoal mate? *Current Biology*, 14, R503-R504.
- Peresson, L. and Eklov, P. (1995). Prey refuges affecting the interactions between piscivorous perch and juvenile perch and roach. *Ecology*, 76(1), 70-81.
- Peuhkuri, N. (1997). Size-assortative shoaling in fish: the effect of oddity on foraging behaviour. *Animal Behaviour*, 54, 271-278.
- Pitcher, T.J. (1983). Heuristic definitions of fish shoaling behavior. *Animal Behavior*, 31, 611-613.

- Pitcher, T.J. (1986). Functions of shoaling behaviour in teleosts. In: *The Behaviour of Teleost Fish* (pp. 294-337; 540). London: Chapman and Hall.
- Pitcher, T.J. and Parrish, J.K. (1993). Functions of shoaling behaviour in teleosts. In: *The Behaviour of teleost fishes* (pp. 363-439). London: Chapman and Hall.
- Pitcher, T.J. and Wyche, C. (1983). Predator-avoidance tactics of Sand-eel schools: why schools seldom split. In Noakes, D.L.G., Lindquist, B.G., Helfman, G.S., and J.A. Ward (Eds.), *Predators and prey in fishes* (Pp. 193-204). The Hague: Junk.
- Pitcher, T.J. Magurran, A.E. and Winfield, I.J. (1982). Fish in larger shoals find food faster. *Behav. Ecol. Sociobiol.*, 10, 149-151.
- Pitcher, T.J., Magurran, A.E. and Allan, J.R. (1986). Size segregative behavior in minnow shoals. *Journal of Fish Biology, Supplement A*, 29, 83-95.
- Pulliam, H.R. and Caraco, T. (1984). Living in groups: is there an optimal group size? In *Behavioural ecology: an evolutionary approach* (pp. 122-147). Oxford, UK: Blackwell Scientific Publications.
- Ranata, E. Juvonen, S. and Peuhkuri, N. (1992). Further evidence for size-assortative schooling in sticklebacks. *Journal of Fish Biology*, 41, 627-630.
- Rangeley, R.W. and Kramer, D.L. (1998). Density-dependent antipredator tactics and habitat selection in juvenile Pollock. *Ecology*, 79(3), 943-952.
- Reynolds, J. and Gross, M. (1992). Female mate preference enhances offspring growth and reproduction in a fish, *Poecilia reticulata*. *Proc. R. Soc. Long. B.*, 250, 57-62.
- Rita, H. and Ranta, E. (1999). An individual's gain in a foraging group. *Ann. Zool. Fennici.*, 36, 129-138.
- Ritz, D. (1991). The benefits of a good school. *New Scientist*, 1761, 41-43.
- Rosenthal, G.G. (2000). Design considerations and techniques for constructing video stimuli. *Acta Ethologica*, 3, 49-54.
- Rozas, L.P., McIvor, C.C. and Odum, W.E. (1988). Intertidal rivulets and creekbanks: corridors between tidal creeks and marshes. *Mar. Ecol. Prog. Ser.*, 47, 303-307.
- Ruhl, N. and McRobert, S.P. (2005). The effect of sex and shoal size on shoaling behavior in *Danio rerio*. *Journal of Fish Biology*, 67(5), 1318-1326.
- Schlupp, I. and Ryan, M. (1996). Mixed-species shoals and the maintenance of a sexual-asexual mating system in mollies. *Anim. Behav.*, 52, 885-890.
- Snekser, J.L., McRobert, S.P., and Clotfelter, E.D. (2006). Social partner preferences of male and female fighting fish (*Betta splendens*). *Behavioural Processes*, 72, 38-41.
- Spence, R. and Smith, C. (2007). The role of early learning in determining shoaling preferences based on visual cues in the zebrafish *Danio rerio*. *Ethology*, 113, 62-67.
- Street, N.E. and Hart, P.J. (1985). Group size and patch location by the stoneloach, *Noemacheilus barbatulus*, a non-visually foraging predator. *Journal of Fish Biology*, 27, 785-792.
- Theodorakis, C.W. (1989). Size segregation and the effects of oddity on predation risk in minnow schools. *Animal Behaviour*, 38, 496-502.
- Tobler, M., Plath, M., Burmeister, H. and Schlupp, I. (2006). Black spots and female association preferences in a sexual/asexual mating complex (*Poecilia*, Poeciliidae, Teleostei). *Behav. Ecol. Sociobiol.*, 60, 159-165.
- Turnell, E.R., Mann, K.D., Rosenthal, G.G. and Gerlach, G. (2003). Mate choice in zebrafish (*Danio rerio*) analyzed with video-stimulus techniques. *Biological Bulletin*, 205(2), 225-226.

- Wagner, C. M. (1999). Expression of the estuarine species minimum in littoral fish assemblages of the lower Chesapeake Bay tributaries. *Estuaries*, 22(2A), 304-312.
- Ward, A.J.W., Axford, S. and Krause, J. (2003). Cross-species familiarity in shoaling fishes. *Proc. R. Soc. Lond. B.*, 270, 1157-1161.
- Ward, A.J.W., Hoare, D.J., Couzin, I.D., Broom, M. and Krause, J. (2002). The effects of parasitism and body length on positioning within wild fish shoals. *Journal of Animal Ecology*, 71, 10-14.

Chapter 9

SOCIAL CONTEXT AND WITH-IN PAIR BEHAVIOUR MAY MODULATE HORMONAL STRESS RESPONSE IN GREAT TITS (PARUS MAJOR)

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ABSTRACT

The presence of social allies may buffer adverse consequences of social stress. This has mainly been demonstrated in mammals and recently also in birds. The behaviour of social allies might crucially influence to which extent social context may buffer the behavioural and hormonal response to stress. We here examined the influence of social context on the hormonal response to handling stress in great tits (*Parus major*) selected for fast and slow exploration. We tested 16 male-female pairs (8 fast-fast pairs, 8 slow-slow pairs) after the breeding season. We subjected females to handling stress and thereafter observed their behaviour and collected droppings for the following 2½h with their mate being either absent or present when the females came back into her home cage. As control the same females were not handled prior to observation and their mate was present. In addition, we tested 7 fast and 7 slow unpaired females in the conditions control and mate absent. We measured immunoreactive corticosterone metabolites (CM) in droppings using an enzyme immunoassay. Fast females excreted significantly higher CM mean values when they were alone after handling stress (mate absent) than in the control condition and in condition mate present. Slow females tended to show a similar pattern. While fast females increased their locomotory activity, slow females sat close to their mates longer after handling stress compared to control days. Pair mates resting and feeding synchronously excreted lower CM than asynchronous pairs, irrespective of their

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behavioural phenotype. Paired and unpaired females did neither differ in behavioural nor in hormonal stress response, indicating that observed differences between condition mate absent and mate present in paired females were not due to an accumulation of stressors (mate absent plus handling) in condition mate absent. We here show for the first time, that depending on behavioural phenotype birds increased social proximity after a stressful event and that pair synchrony may modulate corticosterone excretion.

Keywords: *corticosterone, stress, social support, selection lines, Parus major*

INTRODUCTION

Benefits of social support have been described in the buffering model (Cohen and Wills 1985), which proposes that due to social context a stressful event might be perceived less intense and/or the magnitude of the physiological stress response might be less pronounced.

Investigations supporting the buffering model have mainly been conducted in mammals with a major focus on mother-infant (squirrel monkeys, *Saimiri*: Levine *et al.* 1993, rats (diverse strains): Levine 2001, reviewed in Hennessy 1997) or peer separations (cattle (diverse strains): Boissy and Le Neindre 1997, guinea pigs, *Cavia aperea*: Hennessy *et al.* 2006, prairie voles, *Microtus ochrogaster*: Ruscio *et al.* 2007). In addition, the presence of a social ally may also reduce behavioural and hormonal stress response to novelty (marmosets, *Callithrix kuhli*: Smith *et al.* 1998, rats: Terranova *et al.* 1999, prairie and meadow, *M. pennsylvanicus*, voles: Stowe *et al.* 2005), leading to increased exploration (e.g. novel food: zebra finches, *Taeniopygia guttata*: Coleman and Mellgren 1994, rats, *Rattus norvegicus*: Galef and Whiskin 2000, capuchin monkeys, *Cebus apella*: Visalberghi and Addessi 2003, novel objects: ravens, *Corvus corax*: Stöwe *et al.* 2006a,b, Stöwe and Kotrschal 2007).

Several factors determine to which extent social context may buffer stress response: firstly the social system of the species: whether, for how long and to how many different individuals affiliative bonds are established. In addition, the familiarity and identity of the social partner may modulate effects of social context. Another crucial factor seems to be the social experience (guinea pigs: Kaiser *et al.* 2007) and the developmental state (guinea pigs: Hennessy *et al.* 2006) of the focus individual determining to which extent social context may buffer stress response and which social partner may efficiently provide social support. Finally, sex-specific differences in hormonal response to social support have been observed (humans, *homo sapiens*: Kirschbaum *et al.* 1995, guinea pigs: Kaiser *et al.* 2003) as well as individual differences in response to social context (van Oers *et al.* 2005, Stöwe and Kotrschal 2007).

After decades of social support mainly being studied in mammals (e.g. reviewed in de Vries *et al.* 2003), more recently evidence for the buffering model and social support in birds is accumulating. In greylag geese, *Anser anser*, the presence of social allies (human foster parents: Frigerio *et al.* 2003, conspecifics: Scheiber *et al.* 2005a) affected the outcome of agonistic interactions and glucocorticosteroid excretion (assessed via immunoreactive corticosterone metabolites in droppings, CM). After agonistic interactions post-conflict affiliation between former opponents (reconciliation) or between former opponents and a bystander (third-party affiliation) may have calming effects (de Waal and van Roosmalen

1979). Not only in primates (Schino 2000), but also in corvids (rooks, *Corvus frugilegus*: Seed *et al.* 2007, ravens: own observation) and in greylag geese (Kotrschal pers. com.) both, initiators and targets of aggression were observed to engage in third-party affiliation with a social partner, exchanging socio-positive behaviours during the post-conflict period.

Generally, calming effects of social context are more pronounced if socio-positive behaviours are exchanged (e.g. pigtail macaques, *Macaca nemestrina*: Boccia *et al.* 1989, baboons, *Papio hamadryas*: Wittig *et al.* 2008). Thus the behaviour of the social partner seem to be a factor modulating hormonal stress response. In ravens socio-positive behaviour (allopreening) was related to CM excretion already in nestlings (Stöwe *et al.* 2008). In cockatiels, *Nymphicus hollandicus*, pairs showing high frequencies of affiliative behaviour and a high degree of behavioural compatibility were more stable than behaviourally less compatible pairs (Spoon *et al.* 2004) and they produced larger clutches and raised more chicks (Spoon *et al.* 2006). Especially for females facing energetic bottle-neck situations such as egg-laying and breeding, stress management and buffered corticosterone excretion may crucially affect fitness and reproductive success. Beside other detrimental consequences on immune defence and body condition (e.g. Sapolsky 2002, Korte *et al.* 2004), chronically elevated levels of corticosteroids lead to increased mobilization of energy reserves (e.g. Holberton *et al.* 1999, Jenni *et al.* 2000, Cockrem *et al.* 2006), which consequently cannot be allocated in reproduction.

Individuals differ in suites of correlated behavioural and physiological characteristics (“personality”, “behavioural syndrome”, “coping style”) leading to a cross-context consistency in how they deal with challenges (Gosling and John 1999, Sih *et al.* 2004, Kralj-Fišer *et al.* 2007). Behavioural phenotypes are genetically and epigenetically heritable (Dingemanse *et al.* 2002, Drent *et al.* 2003, Daisley *et al.* 2004) and they are one factor determining how an individual will respond to stress (reviewed in Cockrem 2007). In the social domain, studies on behavioural phenotypes mainly focussed on aggressive behaviour (Verbeek *et al.* 1996, D’Eath and Burn 2002, lines selected on the base of attack latency: Benus *et al.* 1990, Benus 2001) and coping with defeat (e.g. Carere *et al.* 2001, 2003, Ebner *et al.* 2005). Individual differences in response to social context have been observed with respect to exploratory behaviour (Stöwe and Kotrschal 2007). But despite the wide ranging effects of socio-positive behaviour on physiology (body condition, hormone excretion) and well being, none of the studies so far considered effects of behavioural phenotypes on between pair mate behaviour and stress response modulation due to social context.

We here focus on social support in great tit pairs of lines selected for fast and slow exploration (Drent *et al.* 2003, van Oers *et al.* 2004). Great tits are territorial, non-migratory passerines, which establish monogamous pair bonds. To investigate potential buffering effects of social context on hormonal stress response, we subjected the females to handling stress and once back in their home cage we observed the females with their mate being either absent (neither in visual nor in acoustical contact, condition mate absent) or present (condition mate present). In the control condition we observed the pairs without handling the females prior to observations. Since the mere absence of a pair mate may be a stressor itself, as has been shown for example in zebra finches (Remage-Healey *et al.* 2003), we also tested unpaired females in the control condition and after handling, to compare their stress response to the one of paired females when being without their mate.

In the majority of experiments examining buffering effects of social context, individuals were temporarily transferred into a novel cage either alone or together with a significant

social partner. In this testing paradigm it is sometimes difficult to distinguish which stressor (social separation and novel environment) triggered the increased excretion of corticosteroids (see Hennessy 1997 for detailed discussion). Moreover, none of these studies considered the mutual influence of the social partners affecting each other behaviourally and in the perception of the novel environment, leading to a potential increase in neophobia. To avoid this mutual influence of behaviour towards a novel environment, we chose to stress the females with handling, a commonly used effective stressor (also applied in great tits e.g. Cockrem and Silverin 2002, Carere and van Oers 2004) and compare the females' hormonal and behavioural response after this stressful event in her home-cage in presence or absence of her (when present) unhandled mate.

Since the stressor we used was the same in conditions mate absent and mate present and only *after* the handling stress females were either alone or with their mate, we expected no difference between pairs of the same selection line concerning in maximum CM excretion after the handling stress, but we predicted a modulation of the CM excretion curve due to calming effects of the presence of the mate. We predicted between line differences in hormonal and behavioural stress response patterns. We assumed males to increase socio-positive behaviour towards their mates after handling stress. Since differences in personality have wide-ranging effects on behaviour in different contexts (Koolhaas *et al.* 1999), birds selected for fast and slow exploration may also differ in within-pair behaviour (e.g. differ in amounts of socio-positive behaviours exchanged) both during control trials and after a stressful event.

METHODS

Animals and Housing

We tested adult great tits of lines selected for fast and slow exploration (Drent *et al.* 2003). Breeding pairs were housed in aviaries (2 x 4 x 2.5m). One wall consisting of wire-mesh was facing surrounding garden, the other three walls were opaque. Birds had visual and acoustical contact to other breeding pairs and to same-sex groups of unpaired birds ($n_{\max}=8$ per aviary). Birds had *ad libitum* access to seeds, fruit, water and a mixture of minced meat, seeds and herbs. Once a day they were additionally fed mealworms. Round dishes filled with water served as bathing pools. After birds had completed the clutches, eggs were removed for other studies (cross-fostering, hand-raising).

Not earlier than at least two weeks after the end of the egg-laying pairs were subjects in the present experiment. Mid of May (2007) the first set of subjects (consisting of three fast-fast, three slow-slow male-female pairs and two unpaired females of each line) was transferred from the aviaries to the experimental room (artificial light, day: night rhythm: 14h:10h). Three rows of five cages (0.95 x 0.45 x 0.5m) each were fixed on opposite walls. Cages had solid top, rear and side walls, and wire-mesh at the front side. The bottom of each cage consisted of a drawer filled with wood-chips. Cages were equipped with three perches, diverse feeding trays and bathing tub. Feeding regime was as in the aviaries.

Each pair was kept in two connected adjacent cages, unpaired females alone in one cage each. All birds were familiar with these cages and housing conditions due to earlier

experiments. Still, we allowed three days of habituation to the housing conditions, the social environment in the experimental room and to the experimenter (M.S.) being present and collecting droppings before the first pair was tested. Only after *all* birds housed in the experimental room at a time, have been subjects in the experiments, they were returned into the aviaries, in same-sex groups of maximal eight individuals. We did not move subjects from the experimental room back into the aviaries immediately after they have been tested in all three conditions to keep the social environment constant for all birds. Mid of June the second set of birds was transferred into the experimental room (5 fast-fast pairs, 5 slow-slow pairs, 5 unpaired fast females, 5 unpaired slow females), which remained there until the end of the experiment (end of July 2007).

To facilitate dropping collection we covered the floor of the cages with brown paper, which M.S. put into the cage 24 hours before the onset of the control condition, to habituate the birds to the paper. Before the observations started, M.S. replaced the paper sheets with clean ones in each trial (control condition, condition mate absent and mate present). One day prior to the control condition M.S. repeatedly moved the drawers and simulated sample collection to habituate the birds to the procedure.

Experimental Set-up

In all conditions tests lasted from 10.00 to 12.30 am. On control days M.S. initiated the video-recording and dropping collection after having renewed the paper on the bottom of the cages.

On test days one of the caretakers would enter the room before the onset of the observation, divide the cages of the pairs with an opaque sliding wall, separating the male and the female. After catching of the female (catching time: $\bar{X} \pm SD = 15.3s \pm 14.5$, min: 3s, max: 61s) the caretaker left the experimental room, keeping the female in the hand for 1 min. Thereafter the female was kept for 5 min in a cotton bag, then handled another min and put back into her home-cage. The caretaker removed the separating sliding wall and left the room. M.S. entered and started the video-recording as well as the collection of droppings. We asked the caretakers to handle the birds to avoid the tits associating M.S. to the handling stress and consequently becoming nervous each time she approaches the cage to collect droppings.

In the mate absent condition, the caretaker caught the male during the 5min the females was in the cotton bag. We kept the male in a cage (dimensions like the cages in the experimental room, food and water provided) in another room out of visual or acoustical contact to the female. The male remained separated for the 2½hours of observation. Thereafter he was brought back to the female. During the mate separation, males were not completely isolated. They were kept singly in a cage, but tits taking part in other experiments were housed in the same room.

In test condition mate present, males remained in the cage, thus the pair was united with the caretaker removing the separation wall after having returned the female.

We alternated observations between fast and slow pairs and conducted either condition mate absent or condition mate present first. We observed one female/pair at a time. This way we avoided that a stressed females could potentially affect the behaviour of other females under observation (i.e. a female in a control condition being nervous because of the presence

of a stressed female). Only in the control condition of unpaired females, we collected data of two females parallel. We conducted the stress test with half of the fast unpaired females the day following the control day and the other half after one day of interruption. We did the same for the slow females. Every third week of the experiment we tested unpaired females, the two weeks in between pairs, to balance observations of paired and unpaired females over time (mid May- end of July, detailed testing scheme in Table 1). For logistic reasons we had to test two pairs and four unpaired females in the afternoon (14.00-16.30 pm). Since CM values were in the range of those of birds tested in the morning we included the birds tested in the afternoon in the further data analyses.

Table 1. Scheme of testing sequence. During two weeks we tested four pairs (one fast and one slow pair per week). Every third week we conducted the tests with unpaired females (2 fast and two slow females). In the test conditions we handled the females and thereafter observed their behaviour and collected droppings with their mate being either present (a) or absent (b) when the female came back to her home cage. During the control condition females were not handled prior to observation and their mate was present. We alternated between weeks which test condition (a or b) females experienced first

day 1	day 2	day 3	day 4	day 5	day 6	day 7
pair A control	pair A condition a			pair A condition b	--	
		pair B control	pair B condition a		--	pair B condition b
day 8	day 9	day 10	day 11	day 12	day 13	day 14
pair C control	pair C condition b			pair C condition a	--	
		pair D control	pair D condition b		--	pair C condition a
day 15	day 16	day 17	day 18	day 19	day 20	day 21
female I control	female I condition a		female III control	female III condition a		
female II control		female II condition a	female IV control		female IV condition a	

BEHAVIOURAL OBSERVATIONS

We videotaped (JVC, digital video camera, GR-DVX7) the behaviour of the subjects during the first hour of observation in each experimental condition and observed the behaviour of males and females or the unpaired females from minutes 1-10, 25-35, 50-60. Each parameter was measured separately for each individual. We assessed the number/duration of a behaviour per minute of observation. We noted locomotory activity (number of: hops and flights between perches, between a perch and the wire or the ground),

the time birds spent resting (seconds, sitting with one leg lifted up, sitting longer than 3s without moving, the feathers slightly ruffled, the body lowered) and the feeding duration (manipulation/ingestion of food items, seconds). Sitting within a distance of less than 20cm was recorded as socio-positive behaviour (duration in seconds). We never observed birds preening or feeding each other.

FAECAL SAMPLE COLLECTION AND ANALYSIS OF CORTICOSTEROID HORMONE METABOLITES

During the 2½hours data collection M.S. sat in front of the cages to track which dropping belonged to which bird (the male or the female of the pair). In 15min intervals droppings were collected in plastic tubes and stored on ice. Immediately after the end of the observation samples were frozen at -20°C until analysis. Before pooling the samples per individual and 15min interval, M.S. noted the number of droppings the male and female / the unpaired female excreted (see Table 2). In case a dropping could not be attributed to the male or the female (i.e. M.S. did not see which bird it came from), it was not collected. This was the case for mean±SD = 4±2 droppings out of 18-37 droppings per pair in the control and mate present condition. However, it is not likely that this loss of data in the control and mate present condition remarkably affected the results. Scheiber *et al.* (2005b) determined in greylag geese that three samples were sufficient to consistently assess differences in CM between a control condition and after a social density stress, when CM maxima were used for analysis. Four or more samples were required when working with the mean. In the present study we pooled samples of two 15min intervals, in case the amount of faeces per 15min interval was too low for analysis, resulting in mean±SD = 6±2 pooled samples per bird per condition. For the hormone analysis we followed the protocol described in Stöwe *et al.* (2008), only quantities of faeces and proportionally also of chemicals differed. In brief, 0.025g of wet faeces were shaken in a mixture of methanol (0.15ml, 96%) and distilled water (0.1ml). 0.05ml of this extract were evaporated and afterwards dissolved in 0.5ml Na-acetate buffer and 0.2µl β-glucuronidase-arylsulfatase (Merck 4114) and hydrolyzed for 18h. The enzyme immunoassay assay used in Stöwe (*et al.* 2008) has been validated for great tit droppings previously (Carere *et al.* 2003). It shows crossreactions not only with C₁₉O₃ steroids but also with C₂₁O₄ metabolites that have a 3α-ol, 11-oxo structure, therefore measuring 3α,11oxo-CM (detailed description in Möstl *et al.* 2002). Samples were assayed in duplicate. Intra-assay variation was 10%, inter-assay variations were 10.37% for the low level pool (we pooled droppings of females on control days) and 6.13% for the high level pool (here we used samples after we had handled the females).

CM peaked after $\bar{X} \pm SD = 1\text{h } 46\text{min} \pm 30\text{min}$, which indicates that the main part of immunoreactive corticosterone metabolites detected, were excreted in the faeces, because in the urine CM peaks in response to a stressor are excreted earlier (Palme *et al.* 1996, Touma *et al.* 2003)

The number of droppings (see Table 2) excreted during the 2½hours of observation did not relate to mean CM values. In none of the test conditions, the number of droppings excreted related to mean CM values neither in males, nor in females (Spearman rank order correlation coefficients ranging from $r_s = -0.01$ to $r_s = -0.49$, $p > 0.05$).

Table 2. The number of droppings birds excreted in the different test conditions

subjects	n droppings, mean±SD		
	control condition	mate present	mate absent
fast paired females, n=6	13±3	13±5	16±6
fast paired males, n=6	14±4	13±4	
slow paired females, n=8	12±4	12±2	15±5
slow paired males, n=8	13±4	11±3	
fast unpaired females, n=6	20±7		16±2
slow unpaired females, n=6	22±2		20±4

DATA PROCESSING

Females of two fast pairs and two unpaired females (one of the fast and one of the slow selection line) excreted higher amounts of CM in the control condition than after handling stress. In addition, their CM means on control days were five to nine times higher than those of the other same selection line females (on control days), and the CM excretion pattern looked like a stress response curve. After handling the CM values were in the range of the those of the other same line females. Therefore, we assume unnoticed disturbances or stressful events on (on four out of 76 days of observation) before the onset of the control trials with these four females. Consequently we are missing valuable control data of these individuals and we excluded these two pairs and two females from the data analysis.

Data of the two sets of birds tested (transferred into the experimental room mid of Mai and mid of June respectively) did not differ significantly, therefore we do not distinguish between the two sets of birds in the data analysis. Between line differences did not reach significance level.

For data analysis we calculated the sum (number or duration depending on the parameter) per behavioural parameter measured during the 30min of behavioural observation and the mean of the CM values measured per individual during the 2½hours of observation.

To asses within pair synchrony we calculated Kendall-Tau-b correlation coefficients the time the female of a pair spent feeding /resting per minute of observation, with the time the male spent feeding /resting per observation minute (n=30 per pair). If the time birds spent resting/feeding correlated between pair-mates, we defined the pair as behaving synchronously. We did not include locomotory behaviour in this calculation, because if one bird is active in the relatively small experimental cages, the pair mate might be active too, in order to retreat, avoid contact or search contact. Thus, locomotory behaviour expressed synchronously could have been a by effect of keeping condition rather than a parameter of pair bond quality or affiliative relationships. Three pairs did not feed during the observation period, therefore n=11 pairs in the analysis of feeding synchrony.

We run a stratified data analysis with the selection line as stratification variable. When n=8 or lower, data were analysed by hand according to Siegel and Castellan (1988). Kendall-Tau-b correlation coefficients were calculated using the software package SPSS (2001). Only

non-parametric tests were used. Test results are given two-tailed. $0.1 > \alpha > 0.05$ were considered as trends.

RESULTS

Pairs

Fast paired females excreted significantly higher CM mean values when they were alone after handling stress (condition mate absent) compared to the control and the mate present condition (Friedman test: $df=2$, $n=6$, $\chi^2=7$, $p=0.03$, post-hoc test for multiple comparison between conditions: control < mate absent, $p < 0.05$, Figure 1a), slow females tended to show a similar pattern (Friedman test: $df=2$, $n=8$, $\chi^2=4.75$, $p=0.093$, Figure 1b). CM maxima excreted after handling stress did not differ between conditions mate absent and mate present (Wilcoxon signed ranks test, hereafter referred to as Wilcoxon test: fast females: $n=6$, $T^+=12$, $p=0.84$, slow females: $n=8$, $T^+=19$, $p=0.94$). Fast females significantly increased their locomotory activity when they were without their mate (condition mate absent) compared to conditions mate present and control (Friedman test: $df=2$, $n=6$, $\chi^2=7.0$, $p=0.03$, post-hoc test for multiple comparison between conditions: mate absent > mate present, $p < 0.05$). Slow females, in contrast, did not show augmented locomotory activity when alone (Friedman test: $df=2$, $n=8$, $\chi^2=0.84$, $p=0.66$). There was no between condition difference in the time birds spent resting (Friedman test: $df=2$, fast birds: $n=6$, $\chi^2=2.33$, $p=0.31$ slow birds: $n=8$, $\chi^2=2.25$, $p=0.33$). Slow females tended to feed longer in the control condition than after handling stress (conditions mate absent and mate present; Friedman test: $df=2$, $n=8$, $\chi^2=5.85$, $p=0.054$, post-hoc test for multiple comparison between conditions: control > mate absent, control > mate present, $p < 0.05$). We did not observe any between condition difference in feeding activity of fast females (Friedman test: $df=2$, $n=6$, $\chi^2=0.087$, $p=0.96$). After handling slow birds tended to spend more time sitting close to their mates as compared to the control condition (Wilcoxon test: $n=8$, $T^+=32$, $p=0.054$, Figure 2), while fast females did not (Wilcoxon test: $n=6$, $T^+=16$, $p=0.31$, Figure 2). There was no difference between males and females in how often they initiated sitting close to their mate (Mann Whitney-U test: control condition: fast pairs: $n_{f=m}=6$, $W_f=37.5$, $W_m=40.5$, $p=0.87$, slow pairs: $n_{f=m}=8$, $W_f=60$, $W_m=76$, $p=0.44$; condition mate present: fast pairs: $n_{f=m}=6$, $W_f=27$, $W_m=44$, $p=0.48$, slow pairs: $n_{f=m}=8$, $W_f=71.5$, $W_m=64.5$, $p=0.72$).

Mean CM values did not differ between females that were tested in condition mate absent first and those that were tested this condition secondly (Mann Whitney-U test: resting: $n_1=5$, $n_2=9$, $W_x=36$, $W_y=69$, $p=0.89$).

In males mean CM values did not differ between test conditions (control and mate present, Wilcoxon test: fast males: $n=6$, $T^+=16$, $p=0.31$, slow males: $n=8$, $T^+=20$, $p=0.84$), nor did locomotory activity (Wilcoxon test: fast males: $n=6$, $T^+=13$, $p=0.69$, slow males: $n=8$, $T^+=24$, $p=0.46$) and feeding duration (Wilcoxon test: fast males: $n=6$, $T^+=15$, $p=0.44$, slow males: $n=8$, $T^+=25$, $p=0.38$). Slow males tended to spend more time resting in condition mate present than during the control trials (Wilcoxon test: fast males: $n=6$, $T^+=14$, $p=0.56$, slow males: $n=8$, $T^+=31$, $p=0.078$).

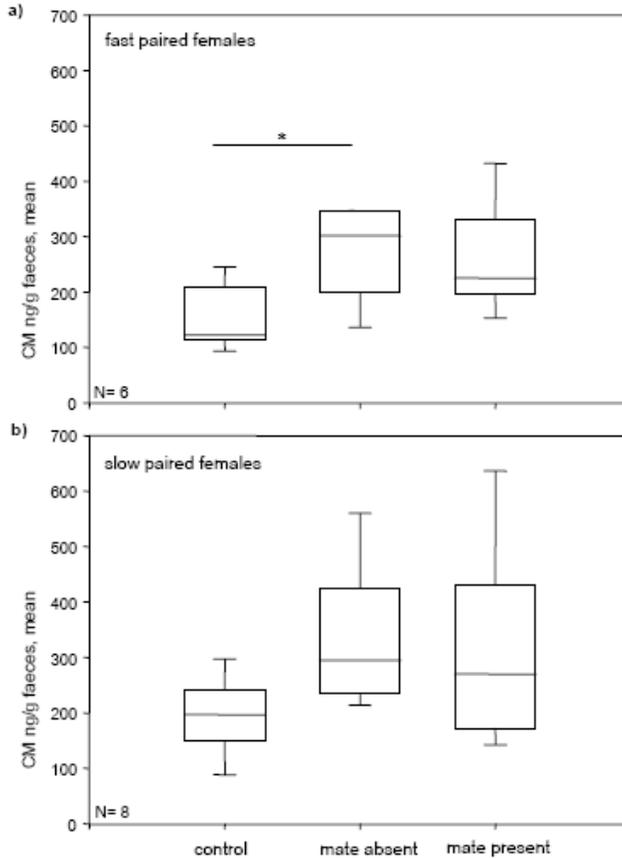


Figure 1. Amounts of immunoreactive corticosterone metabolites (CM, mean, ng/g faeces) fast (a) and slow (b) paired females excreted during the differed test conditions. N=number of birds, box plots show the median and the interquartile range from the 25th to the 75th percentile. Whiskers above and below the box indicate the 10th and the 90th percentiles. The asterisk marks significant between-condition difference as determined by post hoc tests for multiple comparisons for Friedman two-way analyses of variance by ranks (* $p < 0.05$).

WITHIN PAIR SYNCHRONY

Irrespective of behavioural phenotype (fast or slow), in pairs resting synchronously, females excreted significantly less CM in the control condition than females in asynchronous pairs (Mann Whitney-U test: females: $n_1=6$, $n_2=8$, $W_x=28$, $W_y=77$, $p < 0.029$, Figure 3, males: $n_1=6$, $n_2=8$, $W_x=35$, $W_y=70$, $p=0.22$). Males feeding synchronously with their mates had lower CM values compared to males feeding asynchronously during control trials (Mann Whitney-U test: females: $n_1=6$, $n_2=5$, $W_x=32$, $W_y=34$, $p=0.51$, males: $n_1=6$, $n_2=5$, $W_x=22$, $W_y=44$, $p < 0.01$).

In the condition mate present, females tended to excrete lower mean CM when feeding synchronously with their mates compared to females that did not (Mann Whitney-U test: $n_1=4$, $n_2=7$, $W_x=15$, $W_y=51$, $p=0.089$).

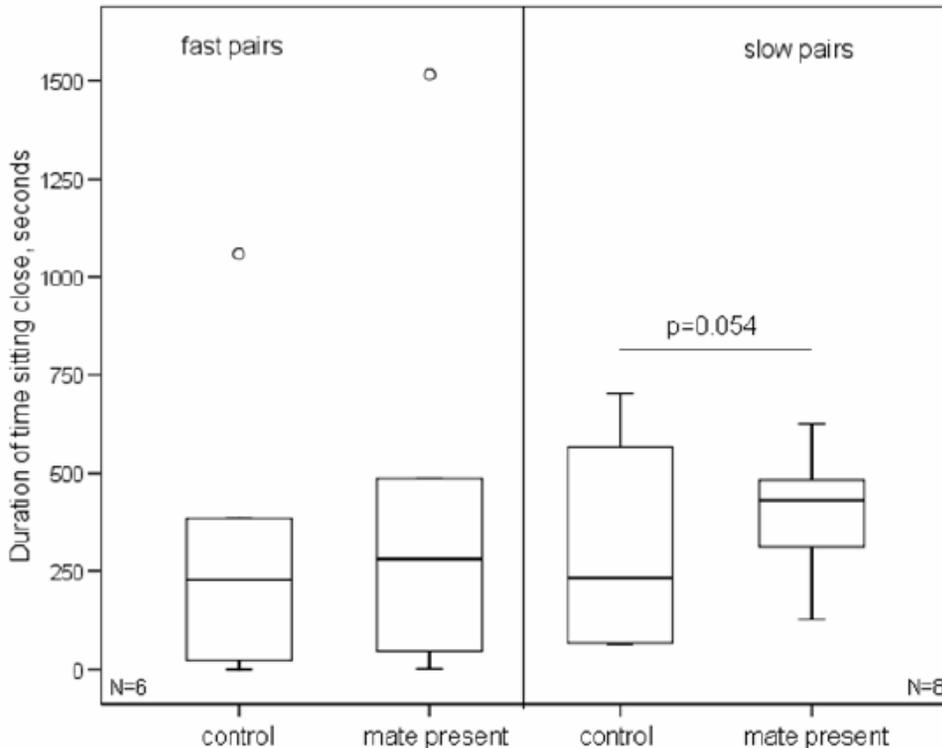


Figure 2. Time spent sitting close to the mate (distance between pair mates <20cm) in the control and mate present condition (between condition comparison using the Wilcoxon signed ranks test). N=number of pairs.

We did not observe any difference in CM concerning resting synchronously (Mann Whitney-U test: $n_1=8$, $n_2=6$, $W_x=62$, $W_y=43$, $p=0.89$). Males, in contrast, tended to excrete lower CM when resting synchronously with their mate, but not when feeding in synchrony (Mann Whitney-U test: feeding: $n_1=4$, $n_2=7$, $W_x=19$, $W_y=47$, $p=0.41$ resting: $n_1=8$, $n_2=6$, $W_x=45$, $W_y=60$, $p=0.058$).

UNPAIRED FEMALES

All unpaired females excreted significantly higher amounts of CM after having been handled compared to control days (Wilcoxon test: $n=6$, fast females: $T^+=21$, $p=0.031$, slow females: $T^+=21$, $p=0.031$). Females of both lines tended to feed longer during control trials than on test days (Wilcoxon test: $n=6$, fast females: $T^+=19$, $p=0.092$, slow females: $T^+=20$, $p=0.063$). Slow but not fast females tended to rest longer during test trials as compared to control trials (Wilcoxon test : $n=6$, fast females: $T^+=12$, $p=0.84$, slow females: $T^+=19$, $p=0.092$).

In none of the parameters measured paired fast females differed significantly from unpaired fast females, neither in the control condition nor in the mate absent condition (Table 3).

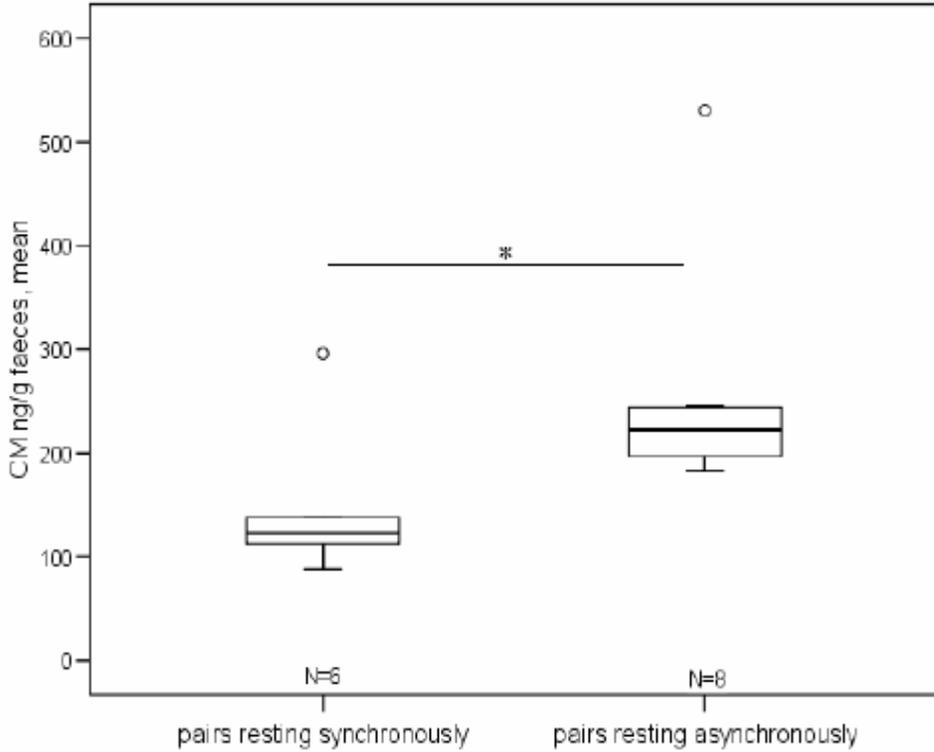


Figure 3. Comparison of females' CM (mean, ng/g faeces) levels during the control condition of pairs resting synchronously or asynchronously, (irrespective of selection line, Mann Whitney-U test, * $p < 0.05$). N=number of pairs.

Table 3. Comparison of paired and unpaired females. We used the Mann Whitney-U test to compare behaviour and CM excretion of paired and unpaired females in the control condition and after handling stress (condition a). Wx: unpaired females, Wy: paired females

parameter	condition	fast females, n1=n2=6	slow females, n1=6, n2=8
CM	control	Wx=39, Wy=39, p=1.0	Wx=35, Wy=70, p=0.22
locomotory activity	control	Wx=49, Wy=29, p=0.13	Wx=56, Wy=49, p=0.18
resting, duration (s)	control	Wx=37, Wy=41, p=0.82	Wx=38, Wy=67, p=0.41
feeding, duration (s)	control	Wx=42, Wy=36, p=0.70	Wx=42, Wy=63, p=0.74
CM	test a	Wx=37, Wy=41, p=0.82	Wx=45, Wy=60, p=0.99
locomotory activity	test a	Wx=41, Wy=37, p=0.82	Wx=45, Wy=60, p=0.99
resting, duration (s)	test a	Wx=40, Wy=38, p=0.94	Wx=43, Wy=62, p=0.85
feeding, duration (s)	test a	Wx=36, Wy=42, p=0.70	Wx=40.5, Wy=60.5, p=0.57

DISCUSSION

The presence of the pair mate after a stressful event indeed affected the hormonal and behavioural stress response in great tit females. Fast females excreted significantly higher mean amounts of CM when alone after handling stress as compared to the control condition or when their mate was present. This indicates that the presence of the social partner had buffering effects on hormonal stress response. Slow females tended to show a similar pattern, however the differences between conditions were less pronounced. Alternatively to the buffering hypothesis (Cohen and Wills 1985), the absence of the pair mate in the mate absent condition could have been an additional stressor (handling *and* absence of the mate) leading to higher mean CM values. Mate separation commonly leads to increased corticosteroid secretion (e.g.: zebra finches: Remage-Healey *et al.* 2003). However, comparing unpaired great tit females in our experiment to paired females when without their mate, neither hormonal nor behavioural stress response differed significantly. On test days (with handling stress) unpaired females were not exposed to a potential accumulation of stressors (mate absent and handling stress) and they did not excrete lower levels of CM compared to paired females. Therefore, it seems that the presence of the mate had calming effects rather than an accumulation of stressors being responsible for the increased CM excretion of paired females in the mate absent condition compared.

In both conditions (mate absent, mate present) females remained with their mates until the handling stress, the stressor was the same and females were always alone during handling, thus the circumstances eliciting the hormonal stress response did not differ between conditions. Thus, we expected a modification in the CM excretion curve due to the presence of the mate rather than a difference in CM maxima. Indeed, we did neither observe a significant difference in the time until CM peaked nor did CM maxima differ between conditions mate absent and mate present, irrespective of the females' behavioural phenotypes.

A potential mechanism how calming effects of social context may influence CM could be a modulation of adrenocorticotrophic hormone (ACTH) secretion after a stressful event. Such that stressed individuals stop ACTH secretion in response to a stressor quicker when a social ally is present compared to when alone. If so, social support should lead to a steeper decrease in CM after the CM peak in response to a stressful event. Since the females excreted CM maxima only after $\bar{X} \pm SD = 1\text{h } 46\text{min} \pm 30\text{min}$ and they did not return to CM control levels during the 2½hours observation period, we unfortunately can not compare CM decrease curves between conditions. However, CM mean values differed between conditions. These observed between condition differences in CM mean values could be due to CM excreted in the urine fraction (where CM are excreted with less delay compared to faeces, e.g. Palme *et al.* 1996, Touma *et al.* 2003). In addition to the urine contained in droppings, the metabolization in the liver and excretion via gut and kidneys, immunoreactive corticosterone metabolites may diffuse through the gut walls and thus be in part measured before the peak excretion. Nevertheless, it would be useful in future experiments to extend the test duration to be able to properly compare CM decline curves between the selection lines with and without social support after a stressful event.

In the present study between line differences surprisingly did not reach significance level. With an extended period of dropping collection and the comparison of CM decline curves after the handling stress, differences between the selection lines might have been more

pronounced. Besides, the relatively low sample size per line and individual variation within the lines may have rendered between line differences less pronounced.

Carere (*et al.* 2003) observed that CM excretion increased in slow male great tits 45min after having been defeated in an agonistic male-male interaction. The day after the conflict slow males had lower CM values compared to baseline levels. Fast males did not show these changes in CM excretion. In our experiment females of both lines significantly increased CM excretion in response to handling stress, with fast females being hormonally more responsive to the presence of the mate after a stressful event than slow females.

Females of the slow line tended to spend more time sitting close to their mate, after having been handled compared to control days. This could reflect an increased need of social support after a stressful event. When comparing how often males and females initiated sitting close to their mate (i.e. how often the male approached the female and vice versa), we did not observe differences between the sexes. This could be due to the fact that both, the males and the females increased socio-positive behaviour. The males might have increased the time sitting close to their stressed mate, as we expected. While stressed females might have actively searched proximity to their mate. Following agonistic interactions in rooks, both, individuals involved in the fight and uninvolved third parties initiated affiliative contacts (Seed *et al.* 2007). Thus, also in the rooks' case not only those individuals directly involved in a stressful event increased social proximity.

We here show for the first time, that depending on the behavioural phenotype birds show differences in social support expressed: only slow birds spent more time sitting close to their mate after a stressful event. This differences between females of the selection lines in need/use of passive social support could be an additional factor influencing mate choice. Indeed, assortative mated free living great tit pairs, assortative with respect to their behavioural phenotype (slow-slow pairs and fast-fast pairs), produced offspring in best condition (Both *et al.* 2005). Concerning the number of recruits (young being present in the following spring) the pattern is less clear: after a winter with abundant food (mass seeding of European beech, *Fagus sylvatica*) most recruits came from assortatively mated parents. After a winter with worse food conditions birds of an intermediate exploratory behaviour produced most recruits (Dingemanse *et al.* 2004).

Beside slow males resting more in the mate present condition compared to control trials, we neither observed differences in behaviour nor in CM in males. This indicates that the catching of the mate, her absence for 7min and her coming back stressed, did not elicit increased agitation (e.g. reflected in locomotory activity) or a hormonal stress response in the males. The increased time slow males spent resting in the test condition could be due to them being more familiar to the test procedure, including dropping collection compared to control trials, even though birds were habituated to the dropping collection procedure (i.e. to M.S. partly pulling out the drawers) before the onset of the experiment.

Irrespective of behavioural phenotype, pair mates feeding and resting synchronously excreted lower CM compared to those behaving asynchronously. To a certain extent, synchronous resting and feeding could be related to daily rhythms, time after feeding (all birds were fed in the morning before the onset of the experiment) and motivation transfer (*Stimmungsübertragung*). However, preferred food (mealworms and seeds mixed with meat) could be monopolised and some males did (males are dominant over females in great tits, Dingemanse and de Goede 2004). Thus, in pairs feeding synchronously males tolerated females feeding at the same time and did not monopolise food sources while they were

feeding themselves. In addition, feeding motivation transfer should not be related to CM excretion in the dominant males, because they would not be limited in behaving according to their needs (e.g. unlimited access to food). Therefore, synchronous behaviour observed seems to reflect partner compatibility or harmony rather than being just a by-product of daily rhythms. Mate compatibility is an important attribute of pair bond quality affecting long term success and fitness. Spoon (*et al.* 2004, 2006), for example, could demonstrate in cockatiels, *Nymphicus hollandicus*, that pairs showing higher frequencies of affiliative behaviour and a high degree of behavioural compatibility were more stable and raised more chicks than behaviourally less compatible pairs. Synchrony between pair partners is not limited to behaviour. Year round testosterone co-variation was positively correlated with the pair's long-term productivity (mean number of fledged young per year of the pair-bond) in greylag geese (Hirschenhauser *et al.* 1999). In addition, pairs successfully rearing young until fledging, were acting synchronously more often and for longer periods of time than mates in unsuccessful pairs did (Nedelcu pers. com.). Our results highlight, that partner compatibility also plays an important role in coping with stressful events and in buffered stress response, which is indirectly linked to reproductive success. Elevated corticosteroids lead to increased mobilisation of fat reserves, which are consequently not available to be invested in reproduction (e.g. number and weight of eggs). Thus, a good "stress management" and low corticosteroid values have long term fitness consequences on body condition, health, immune response and reproductive success. We here could observe calming effects due to the presence of the mate and increased socio-positive behaviours exchanged following a stressful event, even if pairs had not been allowed to freely choose their mates. Even if we did not observe between line differences in within-pair behaviour, it seems precipitate to conclude that fast and slow explorers generally do not differ in behaviour towards their mate. Before doing so, pairs formed on the basis of mate choice should be observed in different seasons. Between line differences may in stages (i.e. during pair bond formation) be more pronounced than in others.

Long term mate separation (several weeks) and social isolation are linked to an increase of HPA-axis function, anxiety and inactivity (e.g. siberian dwarf hamster, *Phodopus sungorus*: Castro and Matt 1997, prairie voles: Ruscio *et al.* 2007). In our experiment, unpaired females did neither differ from paired females in behavioural nor in hormonal parameters. Unlike individuals kept in social isolation (for example in the above mentioned studies), unpaired females in our experiments were housed in same-sex groups until we transferred them into the experimental room, where they remained in visual and auditory contact with conspecifics. These social housing conditions without mate separation before the onset of the experiment may explain, why we did not observe differences between paired and unpaired females in baseline CM.

CONCLUSION

In line with the buffering model of social context, the presence of the pair mate after a stressful event indeed reduced hormonal stress response in great tit females. We here show for the first time, that depending on the behavioural phenotype birds show differences in social support expressed: only slow birds spent more time sitting close to their mate after a

stressful event. In addition, pair mates resting and feeding synchronously excreted lower CM than pairs behaving asynchronously. These results highlight that partner compatibility and synchrony affect corticosterone excretion also in response to stressful events. Since individuals with different behavioural phenotypes seem to differ in the use/need of social support and social proximity, assortative mating could be advantageous with respect to stress management and the buffering effect due to the presence of the mate.

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REFERENCES

- Benus, R. F. (2001). Coping in female mice from lines bidirectionally selected for male aggression. *Behaviour*, 138, 997–1008.
- Benus, R. F., den Daas, S., Koolhaas, J. M. and van Oortmerssen, G. A. (1990). Routine formation and flexibility in social and non-social behaviour of aggressive and non-aggressive male mice. *Behaviour*, 112, 176–193.
- Boccia, M. L., Reite, M. and Laudenslager, M. (1989). On the physiology of grooming in a pigtail macaque. *Physiology and Behavior*, 45, 667–670.
- Boissy, A. and Le Neindre, P. (1997). Behavioral, cardiac and cortisol responses to brief peer separation and reunion in cattle. *Physiology and Behavior*, 61, 693–699.
- Both, C., Dingemanse, N. J., Drent, P. J. and Tinbergen, J. M. (2005). Pairs of extreme avian personalities have highest reproductive success. *Journal of Animal Ecology*, 74, 667–674.
- Carere, C., Welink, D., Drent, P. J., Koolhaas, J. M. and Groothuis, T. G. G. (2001). Effects of social defeat in a territorial bird (*Parus major*) selected for different coping styles. *Physiology and Behavior*, 73, 427–433.
- Carere, C., Groothuis, T. G. G., Möstl, E., Dann, S. and Koolhaas, J. M. (2003). Fecal corticosteroids in a territorial bird selected for different personalities: daily rhythm and the response to social stress. *Hormones and Behavior*, 43, 540–548.
- Carere, C. and van Oers, K. (2004). Shy and bold great tits (*Parus major*): body temperature and breath rate in response to handling stress. *Physiology and Behavior*, 82, 905–912.
- Castro, W. L. R. and Matt, K. S. (1997). Neuroendocrine correlates of separation stress in the siberian dwarf hamster (*Phodopus sungorus*). *Physiology and Behavior*, 61, 477–484.
- Cockrem, J. F. (2007). Stress, corticosterone responses and avian personalities. *Journal of Ornithology*, 148, Suppl. 2, 169–178.

- Cockrem, J. F., Potter, M. A. and Candy, E. J. (2006). Corticosterone in relation to body weight in Adelie penguins (*Pygoscelis adeliae*) affected by unusual sea ice conditions at Ross Island, Antarctica. *General and Comparative Endocrinology*, *149*, 244-252.
- Cockrem, J. F. and Silverin, B. (2002). Variation within and between birds in corticosterone response of great tits (*Parus major*). *General and Comparative Endocrinology*, *125*, 197-206.
- Cohen, S. and Wills, T. A. (1985). Stress, social support and the buffering hypothesis. *Psychological Bulletin*, *98*, 310-357.
- Coleman, S. L. and Mellgren, R. L. (1994). Neophobia when feeding alone or in flocks in zebra finches, *Taeniopygia guttata*. *Animal Behaviour*, *48*, 903-907.
- Daisley, J. N., Bromundt, V., Möstl, E. and Kotrschal, K. (2004). Enhanced yolk testosterone influences phenotype independent of sex in Japanese quail chicks *Coturnix japonica*. *Hormones and Behavior*, *47*, 185-194.
- D'Eath, R. B. and Burn, C. C. (2002). Individual differences in behaviour: a test of "coping style" does not predict resident intruder aggressiveness in pigs. *Behaviour* *139*, 1175-1194.
- Dingemanse, N. J. and de Goede, P. (2004). The relation between dominance and exploratory behaviour is context-dependent in wild great tits. *Behavioral Ecology*, *15*, 1023-1030.
- Dingemanse, N. J., Both, C., Drent, P. J., van Oers, K. and van Noordwijk, A. J. (2002). Repeatability and heritability of exploratory behaviour in great tits from the wild. *Animal Behaviour*, *64*, 929-937.
- Dingemanse, N. J., Both, C., Drent, P. J. and Tinbergen, J. M. (2004). Fitness consequences of avian personalities in a fluctuating environment. *Proceedings of the Royal Society of London, Series B*, *271*, 847-852.
- Drent, P. J., van Oers, K. and van Noordwijk, A. J. (2003). Realised heritability of personalities in the great tit (*Parus major*). *Proceedings of the Royal Society of London, Series B*, *270*, 45-51.
- Ebner, K., Wotjak, C. T., Landgraf, R. and Engelmann, M. (2005). Neuroendocrine and behavioural response to social confrontation: residents versus intruders, active versus passive coping styles. *Hormones and Behavior*, *47*, 14-21.
- Frigerio, D., Weiss, B., Dittami, J. and Kotrschal, K. (2003). Social allies modulate corticosterone excretion and increase success in agonistic interactions in juvenile hand-raised greylag geese (*Anser anser*). *Canadian Journal of Zoology*, *81*, 1746-1754.
- Galef Jr., B. G. and Whiskin, E. E. (2000). Social exploitation of intermittently available foods and the social reinstatement of food preference. *Animal Behaviour*, *60*, 611-615.
- Gosling, S. D. and John, O. P. (1999). Personality dimensions in nonhuman animals: A cross-species review. *Current Directions in Psychological Science*, *8*, 69-75.
- Hennessy, M. B. (1997). Hypothalamic-pituitary-adrenal responses to brief social separation. *Neuroscience and Biobehavioral Reviews*, *21*, 11-29.
- Hennessy, M. B., Hornschuh, G., Kaiser, S. and Sachser, N. (2006). Cortisol responses and social buffering: a study throughout the life span. *Hormones and Behavior*, *49*, 383-390.
- Hirschenhauser, K., Möstl, E. and Kotrschal, K. (1999). Within-pair testosterone covariation and reproductive output in greylag geese, *Anser anser*. *Ibis*, *141*, 577-586.
- Holberton, R. L., Marra, P. P. and Moore, F. R. (1999). Endocrine aspects of physiological condition, weather and habitat quality in landbird migrants during the non-breeding period. In N. Adams and R. Slotow (Eds.), *Proceedings of the 22nd International*

- Ornithological Congress University of Natal, Durban* (pp. 847–866). BirdLife South Africa, Johannesburg,
- Jenni, L., Jenni-Eiermann, S. J., Spina, F. and Schwabl, H. (2000). Regulation of protein breakdown and adrenocortical response to stress in birds during migratory flight. *American Journal of Physiology: Regulatory, Integrative and Comparative Physiology*, 278, R1182–R1189.
- Kaiser, S., Kirtzeck, M., Hornschuh, G. and Sachser, N. (2003). Sex-specific difference in social support - a study in female guinea pigs. *Physiology and Behavior* 79, 297–303.
- Kaiser, S., Harderthauer, S., Sachser, N. and Hennessy, M. B. (2007). Social housing conditions around puberty determine later changes in plasma cortisol levels and behavior. *Physiology and Behavior* 90, 405–411.
- Kirschbaum, C., Klauer, T., Filipp, S.-H. and Hellhammer, D. H. (1995). Sex-specific effects of social support on cortisol and subjective responses to acute psychological stress. *Psychosomatic Medicine*, 57, 23–31.
- Koolhaas, J. M., Korte, S. M., de Boer, S. F., van der Vegt, B. J., van Reenen, C. G., Hopster, H., de Jong, I. C., Ruis, M. A. W. and Blokhuis, J. H. (1999). Coping styles in animals: current status in behaviour and stressphysiology. *Neuroscience and Biobehavioral Reviews*, 23, 925–935.
- Korte, S. M., Koolhaas, J. M., Wingfield, J. C. and McEwen, B. S. (2004). The Darwinian concept of stress: benefits of allostasis and costs of allostatic load and the trade-offs in health and disease. *Neuroscience and Biobehavioral Reviews*, 29, 3–38.
- Kralj-Fišer, S., Scheiber, I. B. R., Blejec, A. and Kotrschal, K. (2007). Do personalities show in free-roaming greylag geese? A test of behavioural and physiological consistency over time and across situations. *Hormones and Behavior*, 51, 239–248.
- Levine, S. (2001). Primary social relationships influence the development of the hypothalamic-pituitary-adrenal axis in the rat. *Physiology and Behavior*, 73, 255–260.
- Levine, S., Wiener, S. G. and Coe, C. L. (1993). Temporal and social factors influencing behavioral and hormonal stress response to separation in mother and infant squirrel monkeys. *Psychoneuroendocrinology*, 4, 297–306.
- Möstl, E., Maggs, J. L., Schrötter, G., Besenfelder, U. and Palme, R. (2002). Measurement of cortisol metabolites in faeces of ruminants. *Veterinary Research Communications*, 26, 127–139.
- van Oers, K., Drent, P. J., de Goede, P. and van Noordwijk, A. J. (2004). Realized heritability and repeatability of risk-taking behaviour in relation to avian personalities. *Proceedings of the Royal Society of London, Series B*, 271, 65–73.
- van Oers, K., Klunder, M. and Drent, P. J. (2005). Context dependence of personalities: risk-taking behaviour in a social and non-social situation. *Behavioral Ecology*, 16, 716–723.
- Palme, R., Fischer, P., Schildorfer, H. and Ismail M. N. (1996). Excretion of infused ¹⁴C-steroid hormones via faeces and urine in domestic livestock. *Animal Reproduction Science*, 43, 43–63.
- Remage-Healey, L., Adkins-Regan, E. and Romero, L. M. (2003). Behavioral and adrenocortical responses to mate separation and reunion in the zebra finch. *Hormones and Behavior*, 43, 108–114.
- Ruscio, M. G., Sweeny, T., Hazelton, J., Suppatkul, P. and Carter, C. S. (2007). Social environment regulates corticotropin releasing factor, corticosterone and vasopressin in juvenile prairie voles. *Hormones and Behavior* 51, 54–61.

- Sapolsky, R. M. (2002). Endocrinology of the stress response. In J. B. Becker, S.M. Breedlove, D. Crews and M. McCarthy (Eds.), *Behavioural Endocrinology* (2nd edn., pp. 409-450). Cambridge, Massachusetts: MIT Press.
- Scheiber, I. B. R., Weiß, B. M., Frigerio, D. and Kotrschal, K. (2005a). Active and passive social support in families of greylag geese (*Anser anser*). *Behaviour*, *142*, 1535-1575.
- Scheiber, I. B. R., Kralj, S. and Kotrschal, K. (2005b). Sampling effort/frequency necessary to infer individual acute stress responses from fecal analysis in greylag geese (*Anser anser*). *Ann. N.Y. Acad. Sci.*, *1046*, 154-167.
- Schino, G. (2000). Beyond the primates: expanding the reconciliation horizon. In F. Aureli and F. B. de Waal, (Eds.), *Natural Conflict Resolution* (pp. 225-242). Berkeley, California: University of California Press.
- Seed, A. M., Clayton, N. S. and Emery, N. J. (2007). Postconflict third-party affiliation in rooks, *Corvus frugilegus*. *Current Biology*, *17*, 152-158.
- Siegel, S. and Castellan, N. J. Jr. (1988). *Nonparametric statistics for the behavioural sciences*. (2nd edn.). Singapore: McGraw-Hill.
- Sih, A., Bell, A. and Johnson, C. (2004). Behavioural syndromes: an ecological and evolutionary overview. *Trends in Ecology and Evolution*, *19*, 372-378.
- Smith, T. E., McGeer-Whitworth, B. and French, J. A. (1998). Close proximity of the heterosexual partner reduces the physiological and behavioural consequences of novel-cage housing in black tufted-ear marmosets (*Callithrix kuhli*). *Hormones and Behavior*, *34*, 211-222.
- Spoon, T. R., Milliam J. R. and Owings, D. H. (2004). Variation in the stability of cockatiel (*Nymphus hollandicus*) pair relationships: the role of males, females and mate compatibility. *Behavior*, *141*, 1211-1234.
- Spoon, T. R., Milliam J. R. and Owings, D. H. (2006). The importance of mate behavioural compatibility in parenting and reproductive success by cockatiels, *Nymphicus hollandicus*. *Animal Behaviour*, *71*, 315-326.
- SPSS (2001). *SPSS for Windows*, Version 11.0.1. SPSS, Inc., Chicago.
- Stöwe, M. and Kotrschal, K. (2007). Behavioural phenotypes may determine whether social context facilitates or delays novel object exploration in ravens (*Corvus corax*). *Journal of Ornithology*, *148*, Suppl. 2, 179-184.
- Stöwe, M., Bugnyar, T., Loretto, M-C., Schloegl, C., Range, F., and Kotrschal, K. (2006a). Novel object exploration in ravens (*Corvus corax*): effects of social relationships. *Behavioural Processes*, *73*, 68-75.
- Stöwe, M., Bugnyar, T., Heinrich, B. and Kotrschal K. (2006b). Effects of group size on approach to novel objects in ravens (*Corvus corax*). *Ethology*, *112*, 1074-1088.
- Stöwe, M., Bugnyar, T., Schloegl, C., Heinrich, B., Kotrschal, K. and Möstl, E. (2008). Corticosterone excretion patterns and affiliative behaviour over development in ravens (*Corvus corax*). *Hormones and Behavior*, *53*, 208-216.
- Stowe, J. R., Liu, Y., Curtis, J. T., Freeman, M. E. and Wang, Z. (2005). Species differences in anxiety-related responses in male prairie and meadow voles: the effects of social isolation. *Physiology and Behavior*, *86*, 369-378.
- Terranova, M. L., Cirulli, F. and La Viola, G. (1999). Behavioral and hormonal effects of partner familiarity in periadolescent rat pairs upon novelty exposure. *Psychoneuroendocrinology*, *24*, 639-656.

- Touma, C., Sachser, N., Möstl, E. and Palme, R. (2003). Effects of sex and time of day on metabolism and excretion of corticosterone in urine and feces of mice. *General and Comparative Endocrinology*, 130, 267–278.
- Veenema, A. H., Meijer, O. C., de Kloet, E. R., Koolhaas, J. M. and Bohus, B. G. (2003). Differences in basal and stress-induced HPA regulation of wild house mice selected for high and low aggression. *Hormones and Behavior*, 43, 197–204.
- Verbeek, M. E. M., Bonn, A. and Drent, P. (1996). Exploration, aggressive behaviour and dominance in pair-wise confrontations of juvenile male great tits. *Behaviour*, 133, 945–963.
- Visalberghi, E. and Addessi, E. (2003). Social learning about food in capuchin monkeys. In D. M. Fragaszy and S. Perry S. (Eds.), *The biology of traditions, models and evidence* (pp. 187-212). Cambridge: Cambridge University Press.
- DeVries, A.C, Glasper, E. R. and Detillion, C. E. (2003). Social modulation of stress responses *Physiology and Behavior*, 79, 399–407.
- de Waal, F. B., and van Roosmalen, A. (1979). Reconciliation and consolation among chimpanzees. *Behavioral Ecology and Sociobiology*, 5, 55–66.
- Wittig, R. M., Crockford, C., Lehmann, J., Whitten, P. L., Seyfarth, R. M. and Cheney, D. L. (2008). Focused grooming networks and stress alleviation in wild female baboons. *Hormones and Behavior* in press.

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Chapter 10

INTEGRATING PERSONALITY AND SOCIAL LEARNING IN THE STUDY OF SOCIAL INTERACTIONS AMONG NONHUMAN ANIMALS: A PROMISING APPROACH

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ABSTRACT

Early studies on determinants of social interactions among animals typically focused on the influence of factors such as age, sex, physical attributes, group size or environment. Variation within categories of these factors was often regarded as uninteresting ‘noise’. However, during the past two decades individual variation in behaviour within populations has received increasing attention from researchers. Consistent individual differences in behaviour expressed by personality traits have been studied both from mechanistic and functional perspectives in several animal taxa and have been shown to affect fitness. Personality is also shaped by the social and non-social environment. In group-living species, an individual’s behaviour and the choices it makes are influenced by the behaviour and choices of group members. Social learning is one such form of influence, which can modulate the patterns of social interactions and relationships within a group.

Personality traits and social learning have been reported to affect social and non-social behaviour (e.g. foraging, exploratory behaviour, dominance, aggression, mate choice) in several animal species. However, research on the influence of animal personality and social learning on the several dimensions of social behaviour is still warranted and we believe it would shed new light on the development of social relationships. Therefore, we discuss previous research and suggest future directions for the study of the influence of personality and social learning on social interactions among nonhuman animals.

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INTRODUCTION

Early studies on determinants of social interactions among animals typically focused on the influence of factors such as age, sex, physical attributes, group size or environment. Variation within categories of these factors was often neglected. Research on animal personality and social learning has flourished in the last two decades and could shed new light on the factors that affect social relationships. Therefore, we discuss previous research and suggest future directions for the study of the influence of personality and social learning on social interactions and relationships among nonhuman animals.

INFLUENCE OF PERSONALITY ON SOCIAL RELATIONSHIPS

Although, as stated by Wilson, Clark, Coleman and Dearstyne (1994, p. 442), “almost everyone who observes animals is impressed by the behavioural differences that exist among individuals,” scientists tried until recent years to avoid expressions representative of personality and individual variation was often regarded as uninteresting ‘noise’. Early studies on personality were conducted with laboratory (especially in rodents) or captive animals (non-human primates) and focused on mechanistic and psychological approaches (see review by Gosling, 2001). Behavioural ecologists analysed individual differences based on discrete categories of behaviour, such as alternative reproductive strategies and discrete categories of individuals, like sex, age or size (Wilson, et al., 1994). In the last ten to 20 years animal personality received increasing attention from researchers both from mechanistic and functional perspectives in controlled and natural environments (Gosling, 2001; Réale, Reader, Sol, McDougall, and Dingemans, 2007; Gosling, 2008).

Several studies in different *taxa* have already demonstrated the existence of behavioural characteristics (traits) which are consistent over time and situations that differentiate an individual from the others (e.g. reviewed by McDougall, Réale, Sol, and Reader, 2006; Gosling, 2008). The majority (84%) of personality studies focused on mammals but there are also several reports on species of fish, birds, reptiles, amphibians, arthropods and molluscs (Gosling, 2001).

Traits have been measured in two different ways: recurring to classification (observer ratings) or by codings. Trait codings are more objective than ratings because the former are based on frequencies and durations of behavioural events (McDougall et al., 2006) and reflect genuine attributes of individuals, not merely anthropomorphic projections (Gosling and Vazire, 2002). Moreover, reliability of personality traits was supported by the three criteria used to evaluate the existence of personality (Gosling and Vazire, 2002): (a) assessments show strong levels of interobserver agreement, (b) assessments predict behaviours and real-world outcomes, and (c) do not merely reflect the implicit theories of observers projected onto animals.

Most recent studies investigate ‘behavioural syndromes’, which represent suites of correlated behaviours. ‘Behavioural syndromes’ commonly mentioned are based on five traits (e.g. McDougall et al., 2006): boldness (response behaviours demonstrated in dangerous situations), neophobia (behaviours shown in a new, strange environment), activity (determined in an open-field test), aggressiveness (demonstrated, for example, near an

opponent) and sociability (based on interactions with conspecifics). One example is the proactive-reactive syndrome: 'proactive' individuals can be considered as non-neophobic and exploratory, bold, untamed, aggressive, generally active, non-flexible individuals, whereas 'reactive' individuals are neophobic and 'unexploratory', shy, non-aggressive, less active, and highly flexible (McDougall et al., 2006). To understand the evolution of traits researchers, generally, compare 'behavioural syndromes' between populations and species.

Genetic and epigenetic influences on personality have been demonstrated (McDougall et al., 2006). For example, Saetre et al. (2006) identified genes related to shyness and boldness in two breeds of dogs. Malmkvist and Hansen (2002) observed that offspring from a confident breeding line reacted with more exploratory behaviour than offspring from a fearful breeding line in farm mink, *Mustela vison*, providing evidence for a genetic influence on fearfulness.

Personality is affected by environmental conditions, such as food availability and predation pressure. Carere, Drent, Koolhaas and Groothuis (2005) showed that the limitation of food caused chicks to be faster in exploration. Bell and Sih (2007) demonstrated that predation pressure generates a correlation between boldness and aggressiveness in threespined sticklebacks, *Gasterosteus aculeatus*. Sex differences in personality have also been reported (e.g. spotted hyenas females, *Crocuta crocuta*, tend to be bolder, more confident and less fearful ('assertiveness' dimension) in spotted hyenas, *Crocuta crocuta*; Gosling, 1998). Social learning can also modulate personality traits. For example, in rainbow trout, bold individuals that observed bold demonstrators remained bold when confronted with novel stimuli, while bold individuals that observed shy individuals became more cautious in their reaction to novelty (Frost, Winrow-Giffen, Ashley, and Sneddon, 2007). In addition, some studies refer the influence of maternal care on personality (e.g. Caine, Earle and Reite, 2005, demonstrate in *Macaca nemestrina* that subjects who had undergone a brief maternal separation were rated as less sociable than their nonseparated counterparts). However, there is a lack of investigation relative to the influence of interactions on personality development. Other interesting questions are: is there a sensitive period during which traits can be shaped?, do factors like kinship or age difference determine the influence of interactions on personality traits?

Studies that ascertain an influence of personality on survival and reproductive success sometimes only provide suggestive evidence that personality affects fitness. Based on different activity levels of cricket males, as measured by the time necessary to become active when placed in a novel environment and to emerge from a safe refuge, Kortet and Hedrick (2007) defend that activity levels lead to different antipredator behaviours with possible consequences on fitness. The same was proposed by Hollander, Van Overveld, Tokka and Matthyssen (2008) for great tits: after comparing the intensity of nest defence behaviours between fast and slow explorers, they concluded that fast explorers respond more boldly towards predators and their different anti-predator and reproductive investment strategies could affect fitness. Further research is needed that directly measures fitness consequences of personality traits and behavioural syndromes. Smith and Blumstein (2008) performed a meta-analysis of studies reporting fitness consequences of personality traits and found that bolder individuals had increased reproductive success but lower survival, exploration had a positive effect only on survival and aggression had a positive effect on reproductive success. Sinn, Apiolaza and Moltshaniwskyz (2006) reported that shy and bold squid females have different brood hatching success and fertilization success.

Few studies to date have focused on how personality shapes different dimensions of social interactions, such as maternal care, agonistic and affiliative relationships and mating preferences.

Pajor, Kramer and Fraser (2000) reported significant differences in maternal motivation in pigs, as measured by the time females spent away from their piglets. Those differences were not correlated with conflict over milk allocation between parent and offspring, level of food need, individual difficulty in barrier crossing (that allows females to spend time away from piglets) and different experience in raising young, so the differences in maternal behaviours were attributed to differences in personality.

Several studies have reported correlations between aggressiveness and dominance rank. For example, Houpt, Law and Martinisi (1978) proved that the dominance rank and the frequency of agonistic behaviours performed by horses were correlated: high-ranking individuals were more aggressive. This finding was supported by the results of Arnold and Grassia (1982). Other authors have shown that bolder individuals of brown trout (*Salmo trutta*) are more likely to become dominant (Sundström, Petersson, Höjesjö, Johnsson, and Järvi, 2004) and dominant coyotes are less neophobic than subordinates (Mettler and Shivik, 2007). In great tits, *Parus major*, fast-exploring territorial males have higher dominance ranks but fast-exploring nonterritorial juveniles have lower dominance ranks, suggesting that there is a correlation between dominance and personality that depends on the context (Dingemans and de Goede, 2004). However, experimental studies, which are not based on simple correlations between ranks and observed interactions, are necessary to confirm that personality traits influence social hierarchies and not the opposite.

Research on the influence of personality traits over affiliative relationships conducted to date is scarce. Pellis and McKenna (1992) reported that boldness affects the frequency of play fighting in rats: bold individuals initiate playful contacts more frequently than shy individuals. Explorative and active individuals can be expected to obtain more information about their environment (e.g. resources, mates, predators). Therefore, it would be interesting to examine whether bold, explorative, active and sociable animals are preferred affiliative and playing partners. Moreover, individuals that react similarly to environmental and social stimuli within social groups could be predicted to spend more time in proximity as a by-product of their similar behaviour. Animals that are more similar relative to certain personality traits could then develop stronger affiliative relationships.

Certain personality traits have been reported to affect mating behaviour. In guppies, *Poecilia reticulata*, the males' colour pattern determines female sexual preference, but when females have the chance to observe the behaviour of males in the presence of a predator they prefer to mate with bold males, independently of its coloration. This finding may be related to the fact that bold males have greater willingness to risk approaching predators, so female guppies may use boldness as a phenotypic indicator of male quality because only high-quality individuals could dare approach predators often and survive (Godin and Dugatkin, 1996). Reaney and Backwell (2007) studied mate choice in fiddler crabs, *Uca mjoebergi*, and observed that females prefer to mate with bold males than shy males which could be due several causes: bold males could be more easily encountered, bold males spent more time courting females or bold males' greatest ability to escape predators could be a signal of quality used by females to select mates. Individuals of *Mustela vison* that mated earlier in the breeding season were more 'confident/curious' (Malmkvist and Hansen, 2002).

Although there has been a considerable increase in research on nonhuman animal personality, scientists are still focused on correlations between traits. This reality is comprehensible if we consider that only now a considerable number of scientists of distinct areas understands the importance that personality traits has on animal behaviour. Researchers use different methods based on different concepts to determine the same trait and great inconsistency between expressions and definitions or tests used still remains (Gosling, 2001). It is necessary to establish coherence between studies by basing behavioural tests on standardized methods and validate them by establishing relationships with physiological measures or comparisons with ecological traits (Réale, Reader, Sol, McDougall, and Dingemans, 2007). Future investigation should further examine how different personality traits can influence the several dimensions of social relationships, such as affiliative relationships, aggressive interactions, dominance, sexual behaviours and maternal care. Studies could begin by assessing the influence of personality traits in relationships within social groups and thereafter make comparisons between populations and species to assess their evolutionary consequences.

INFLUENCE OF SOCIAL LEARNING ON SOCIAL RELATIONSHIPS

The different ways in which animals gather and use information resulting from the behaviour of others has been addressed by three related research areas: social learning, public information use and social eavesdropping (Bonnie and Earley, 2007). Social information use has been documented in several animal taxa, including fish (e.g. Dugatkin and Godin, 1993; Laland and Williams, 1997; Swaney, Kendal, Capn, Brown, and Laland, 2001), birds (e.g. Hatch and Lefebvre, 1997; Nicol and Pope, 1999; Benskin, Mann, Lachlan, and Slater, 2002), mammals (e.g. Bailey, Howery, and Boss, 2000; Galef and Whiskin, 2004; Bonnie and de Waal, 2006) and arthropods (e.g. Hebets, 2003).

Social learning is a type of learning that is influenced by observation of, or interaction with, another animal (typically a conspecific) or its products (Galef, 1976; Choleris and Kavaliers, 1999; Zentall, 2004; Bonnie and Earley, 2007) and leads to acquisition of new information, the direction of behaviour towards a novel resource, or the performance of a novel pattern of behaviour (Nicol, 1995). Possible mechanisms of social learning include local and stimulus enhancement, imitation and emulation (Nicol, 1995; Bonnie and Earley, 2007). Social learning is known to affect foraging skills and strategies, food choice, tool use, movement patterns, spatial utilization, predator avoidance, mate choice and cultural repertoires (e.g. Galef, 1976; Galef, 1993; Nicol, 1995; Galef and White, 2000; Galef and Giraldeau, 2001; Griffin, 2004; White, 2004; Bonnie and Earley, 2007). Public information use provides information about the location and quality of resources, whereas social eavesdropping consists of extracting information from signalling interactions between conspecifics (Peake and McGregor, 2004; Bonnie and Earley, 2007).

It is frequently assumed that social learning is adaptive because animals can acquire valuable information about resource exploration (e.g. food, mates) or antipredator behaviours, without the costs of asocial learning by trial-and-error (e.g. time and energy costs of searching, ingesting toxic food, death or injury due to predation) (Galef, 1976; Griffin, 2004; Laland, 2004; Zentall, 2004; Kendal, Coolen, van Bergen, and Laland, 2005; Bonnie and

Earley, 2007). Nevertheless, learning is metabolically costly (Barnard et al., 2006) and therefore social learning likely carries costs in terms of acquisition, storage and utilization of information (Freeberg, 2000; Bonnie and Earley, 2007), as well as reduced accuracy of information (Kendal et al., 2005). Therefore, animals are subject to evolutionary tradeoffs between the acquisition of costly but more accurate information and the use of cheaper but potentially less reliable information (Kendal et al., 2005). For social learning to be adaptive, it cannot be used indiscriminately and animals should adopt strategies that determine the circumstances under which they learn from others and from whom they learn (Laland, 2004).

Despite the numerous studies conducted to date on social learning in several animal species, the ecological circumstances under which animals use social learning and from whom they learn have rarely been investigated empirically (Galef and Giraldeau, 2001; Laland, 2004; Kendal et al., 2005). Learning is an evolutionary strategy which allows animals to survive and adapt to rapid and unpredictable changes in their environment (Zentall, 2004). Therefore, the relative utility of individual and social learning is influenced by the rate of environmental change (Galef and White, 2000, and references therein; Galef and Whiskin, 2004). Opportunism, gregariousness, individual learning ability (Nicol, 1995) and number of individuals adopting individual learning strategies (Laland, 2004; Bonnie and Earley, 2007) may also affect the profitability of social learning strategies in different species and local populations.

Within a group, some individuals may be more salient or influential demonstrators than others and observers may pay selective attention to different individuals depending on factors such as social relationships with demonstrators, skill or experience of demonstrators, and the type of the information to be acquired (Nicol, 1995; Nicol, 2004). This results in directed social learning, which consists of uneven transmission of information or skills through a group as a result of the influence of social structure on social transmission probabilities (Nicol, 2004). Social transmission is enhanced by increasing the number of demonstrators but inhibited by increasing the number of observers and non-performing individuals (i.e. bystanders) (Lefebvre and Giraldeau, 1994; Lefebvre and Helder, 1997).

Not only the presence and proximity of demonstrators but also interactions between demonstrators and observers favour social learning (Dumont and Boissy, 1999; Freeberg, 2000). Several characteristics of the relationship between observers and demonstrators have been reported to affect transmission, such as age (Dugatkin and Godin, 1993; but see Galef and Whiskin, 2004), sex (Benskin et al., 2002), kinship (mother: Dumont and Boissy, 1999; but see Hatch and Lefebvre, 1997; siblings: Valsecchi, Choleris, Moles, Guo, and Mainardi, 1996), familiarity (Valsecchi et al., 1996; Swaney et al., 2001; Benskin et al., 2002), dominance relationships (Nicol and Pope, 1999) and affiliative relationships (Smith, King, and West, 2002; Bonnie and de Waal, 2006; Nicol, 2006).

When analysing the factors that affect social relationships within animal groups, dyadic relationships are often assumed to be established independently from each other and to depend on intrinsic characters of the individuals involved (e.g. age, body size, kinship). However, recent studies focusing mainly on dominance relationships, aggressive behaviour and mating behaviour provide evidence that animals extract and use information provided by the behaviour and choices of conspecifics to guide their own behaviour and choices when establishing social relationships.

There are three sources of information available to observers (i.e. bystanders) of agonistic interactions (reviewed by Peake and McGregor, 2004): signals used during aggression (e.g.

colour changes, vocalizations, displays), nonsignalling aggressive behaviours (e.g. duration and frequency of physical contact) and the interaction itself (e.g. level of escalation of aggression, outcome of the interaction). Most research on the use of social information extracted from agonistic interactions has addressed the effect of the outcome of an agonistic interaction on subsequent interactions, such as winner and loser effects and bystander effects (Dugatkin, 2001; Peake and McGregor, 2004). Winner effect refers to the increased probability of winning after having previously won an agonistic encounter and loser effect is the increased probability of losing after having previously lost an agonistic encounter (Chase, Bartolomeo, and Dugatkin, 1994; Van Doorn, Hengeveld, and Weissing, 2003). The bystander effect consists of a change in the assessment made by the bystander about the fighting abilities of other individuals after having observed an agonistic encounter between them (Dugatkin, 2001). Although these effects can strongly influence dominance hierarchies (e.g. Chase et al., 1994; Dugatkin, 2001; Van Doorn et al., 2003), the extraction of other kinds of social information provided by agonistic interactions deserves further study.

Bystanders can potentially extract information about the interactants other than fighting ability, such as probability of aggression or motivation to defend resources, and use that information in future encounters with them (Peake and McGregor, 2004). For example, such information could cause a subordinate animal to contest the dominance relationship preferentially with a particular dominant individual that was observed to be less aggressive in contests with other individuals.

Furthermore, the benefits and costs incurred by demonstrators from being observed are still unclear. Individuals involved in agonistic interactions have been reported to change their behaviour when they are being observed (Bonnie and Earley, 2007). Therefore, the benefits of being observed winning and the costs of being observed losing agonistic interactions can potentially modulate aggressive strategies and should be measured in future studies.

Several studies have provided strong evidence of social learning in elements of vertebrate courtship systems, such as song traditions in passerine birds, mating preferences and courtship patterns (reviewed by Freeberg, 2000). Social influence on mate choice has also been reported in an invertebrate species, the wolf spider *Schizocosa uetzi* (Hebets, 2003).

One possible mechanism of social influence on mating behaviour is sexual imprinting, which has been extensively documented in several avian species (reviewed by Freeberg, 2000). Sexual imprinting occurs during the sensitive period, is largely irreversible, and causes individuals to direct sexual behaviours preferentially to members of a species, population, or group that exhibit traits characteristic of the parental individuals with which they were raised (Freeberg, 2000). More research is needed to identify the specific behavioural interactions between young and older individuals that influence sexual preferences and to assess the extent to which sexual interactions during adulthood can influence previously established sexual preferences (Freeberg, 2000).

Mate choice copying is another form of social influence which has been documented mostly in fish (Dugatkin and Godin, 1993; Witte and Ryan, 2002) and birds (Freeberg, 2004; Galef and White, 2000; White, 2004) and consists of a change in the probability of courting or mating with an individual of the opposite sex as the result of the observation of mate choice or courtship involving that individual. These socially influenced sexual preferences may extend to similar individuals of the opposite sex through stimulus generalization and spread in the population (Galef and White, 2000; White, 2004). However, the effects of observing mate choice of conspecifics depends on sex in Japanese quail, *Coturnix japonica*:

males become less attracted whereas females become more attracted by individuals of the opposite sex that they had previously observed engaging in courtship or mating behaviours (Galef and White, 2000; White, 2004). These findings suggest that the functions of mate choice copying may differ between the sexes: females learn about traits and behavioural characteristics of the males whereas males determine the likelihood of fertilization of a potential mate (White, 2004). Therefore, the functions of mate choice copying for both sexes should be determined in future studies. More research is also needed on whether and how socially acquired sexual preferences are maintained in individual animals and transmitted over generations (Freeberg, 2000).

In contrast to the extensive body of literature on the influence of social information use over dominance, aggression and sexual behaviours, few studies have examined social transmission of affiliative behaviours and relationships. De Waal (1996) reported that affiliative relationships between female rhesus macaques seemed to be transmitted to offspring by a learning process: young females developed stronger affiliative relationships with the daughters of their mothers' preferred social partners. However, this and other studies that have reported such transmission of bonds from mothers to offspring (e.g. Weeks, Crowell-Davis, Caudle, and Heusner, 2000) were not designed to separate social learning effects from other possible mechanisms of transmission. Direct genetic inheritance of social behaviour or inheritance of personality traits that affect social behaviour and shared environment can also cause similarities in affiliative behaviour (Maestripieri, 2003). Maestripieri (2003) reported that rates of affiliative behaviours resembled more those of biological mothers than those of foster mothers in a cross-fostering study involving rhesus macaques. By contrast, in sheep and goats cross-fostered at birth, play and grooming behaviours are more similar to those of their foster than to those of their genetic species and they prefer to socialize and mate with individuals of their foster mother's species (Kendrick, Haupt, Hinton, Broad, and Skinner, 2001). The findings of Maestripieri (2003) suggest a strong genetic influence on affiliative behaviour whereas those of Kendrick, Haupt, Hinton, Broad and Skinner (2001) provide evidence of social learning. Clearly, more research is needed to assess whether animals use social information to build affiliative relationships and to analyse the influence of conspecifics other than the mother. For example, does choice of a social partner by an individual affect choices made by other individuals similarly to mate choice copying?

The possibility that information extracted from observation of a type of social interaction affects other types of social interaction should also be further investigated. For example, females have been reported to use information on aggressive contests between males to assess their capability of defending resources and their suitability as mates (Bonnie and Earley, 2007). Another kind of social influence to be tested could be that information extracted from aggressive contests affects the choice of same-sex partners for affiliative relationships.

Empirical data on the social learning strategies used by animals are scarce, even for the most studied dimensions of social behaviour, such as mate choice and courtship behaviour (Freeberg, 2000). Future studies could investigate, for example, whether individuals learn more readily social interaction patterns from successful conspecifics, preferred associates, follow the majority or use other criteria such as age and experience of potential demonstrators (Freeberg, 2000; Laland, 2004). Different social learning strategies would lead to different patterns of transmission and could influence social relationships.

More research is also needed on the environmental conditions and social contexts that favour the use of social information when engaging in social interactions and building social relationships. Comparative studies between local populations of species which have already demonstrated the ability to use social information in laboratory studies could contribute to elucidate the influence of environmental conditions and the adaptive value of using social information when establishing social relationships.

CONCLUSION

We have shown that over the past few years scientists have acquired significant information on personality and social learning in animals.

However, empirical investigation of the influence of personality and social learning on social interactions and relationships requires supplementary research. In addition, most research conducted to date consists of laboratory studies in artificial experimental conditions. It is still necessary to determine whether and how personality traits and social information use actually affect the several dimensions of social relationships and reproductive success of nonhuman animals in their natural environment. Experiments conducted in natural settings, although difficult to implement, provide some necessary control over environmental and social variables while still ensuring ecological validity of study results (Galef, 2004). Therefore, we believe that field experiments would provide a promising approach to integrate personality and social learning in the study of social interactions among nonhuman animals.

REFERENCES

- Arnold, G. W., and Grassia, A. (1982). Ethogram of agonistic behaviour for thoroughbred horses. *Applied Animal Ethology*, 8(1), 5-25.
- Bailey, D. W., Howery, L. D., and Boss, D. L. (2000). Effects of social facilitation for locating feeding sites by cattle in an eight-arm radial maze. *Applied Animal Behaviour Science*, 68(2), 93-105.
- Barnard, C. J., Collins, S. A., Daisley, J. N., and Behnke, J. M. (2006). Odour learning and immunity costs in mice. *Behavioural Processes*, 72(1), 74-83.
- Bell, A. M., and Sih, A. (2007). Exposure to predation generates personality in threespined sticklebacks (*Gasterosteus aculeatus*). *Ecology Letters*, 10(9), 828-834.
- Benskin, C. M. H., Mann, N. I., Lachlan, R. F., and Slater, P. J. B. (2002). Social learning directs feeding preferences in the zebra finch, *Taeniopygia guttata*. *Animal Behaviour*, 64(5), 823-828.
- Bonnie, K. E., and de Waal, F. B. M. (2006). Affiliation promotes the transmission of a social custom: handclasp grooming among captive chimpanzees. *Primates*, 47(1), 27-34.
- Bonnie, K. E., and Earley, R. L. (2007). Expanding the scope for social information use. *Animal Behaviour*, 74(2), 171-181.
- Caine, N.G., Earle, H., and Reite, M. (2005). Personality traits of adolescent pig-tailed monkeys (*Macaca nemestrina*): An analysis of social rank and early separation experience. *American Journal of Primatology*, 4(3), 253 – 260.

- Carere, C., Drent, P. J., Koolhaas, J. M., and Groothuis, T. G. G. (2005). Epigenetic effects on personality traits: early food provisioning and sibling competition. *Behaviour*, 142(9-10), 1329-1355.
- Chase, I. D., Bartolomeo, C., and Dugatkin, L. A. (1994). Aggressive interactions and inter-contest interval: how long do winners keep winning? *Animal Behaviour*, 48(2), 393-400.
- Choleris, E., and Kavaliers, M. (1999). Social learning in animals: sex differences and neurobiological analysis. *Pharmacology Biochemistry and Behavior*, 64(4), 767-776.
- de Waal, F. B. (1996). Macaque social culture: development and perpetuation of affiliative networks. *Journal of Comparative Psychology*, 110(2), 147-154.
- Dingemanse, N. J., and de Goede, P. (2004). The relation between dominance and exploratory behavior is context-dependent in wild great tits. *Behavioral Ecology*, 15(6), 1023-1030.
- Dugatkin, L. A. (2001). Bystander effects and the structure of dominance hierarchies. *Behavioral Ecology*, 12(3), 348-352.
- Dugatkin, L. A., and Godin, J. G. J. (1993). Female mate copying in the guppy (*Poecilia reticulata*): age-dependent effects. *Behavioral Ecology*, 4(4), 289-292.
- Dumont, B., and Boissy, A. (1999). Relations sociales et comportement alimentaire au pâturage. *INRA Productions Animales*, 12, 3-10.
- Freeberg, T. M. (2000). Culture and courtship in vertebrates: a review of social learning and transmission of courtship systems and mating patterns. *Behavioural Processes*, 51(1-3), 177-192.
- Freeberg, T. M. (2004). Social transmission of courtship behavior and mating preferences in brown-headed cowbirds, *Molothrus ater*. *Learning and Behavior*, 32(1), 122-130.
- Frost, A. J., Winrow-Giffen, A., Ashley, P. J., and Sneddon, L.U. (2007). Plasticity in animal personality traits: does prior experience alter the degree of boldness? *Proceedings of Biological Sciences*, 274(1608), 333-339.
- Galef, B. G., Jr. (1976). Social transmission of acquired behaviour: A discussion of tradition and social learning in Vertebrates. *Advances in the Study of Behavior*, 3, 77-100.
- Galef, B. G., Jr. (1993). Functions of social learning about food: a causal analysis of effects of diet novelty on preference transmission. *Animal Behaviour*, 46, 257-265.
- Galef, B. G., Jr. (2004). Approaches to the study of traditional behaviors of free-living animals. *Learning and Behavior*, 32(1), 53-61.
- Galef, B. G., Jr., and Giraldeau, L. A. (2001). Social influences on foraging in vertebrates: causal mechanisms and adaptive functions. *Animal Behaviour*, 61(1), 3-15.
- Galef, B. G., Jr., and Whiskin, E. E. (2004). Effects of environmental stability and demonstrator age on social learning of food preferences by young Norway rats. *Animal Behaviour*, 68(4), 897-902.
- Galef, B. G., Jr., and White, D. J. (2000). Evidence of social effects on mate choice in vertebrates. *Behavioural Processes*, 51(1-3), 167-175.
- Godin, J.-G. J., and Dugatkin, L. A. (1996). Female mating preference for bold males in the guppy, *Poecilia reticulata*. *Proceedings of the National Academy of Science*, 93(19), 10262-10267.
- Gosling, S. D. (1998). Personality dimensions in Spotted Hyenas (*Crocuta crocuta*). *Journal of Comparative Psychology*, 112(2), 107-118.
- Gosling, S. D. (2001). From mice to men: What can we learn about personality from animal research? *Psychological Bulletin*, 127(1), 45-86.

- Gosling, S. D. (2008). Personality in Non-human Animals. *Social and Personality Psychology Compass*, 2(2), 985–1001.
- Gosling, S. D., and Vazire, S. (2002). Are we barking up the right tree? Evaluating a comparative approach to personality. *Journal of Research in Personality*, 36, 607–614.
- Griffin, A. S. (2004). Social learning about predators: A review and prospectus. *Learning and Behavior*, 32(1), 131-140.
- Hatch, K. K., and Lefebvre, L. (1997). Does father know best? Social learning from kin and non-kin in juvenile ringdoves. *Behavioural Processes*, 41(1), 1–10.
- Hebets, E. A. (2003). Subadult experience influences adult mate choice in an arthropod: Exposed female wolf spiders prefer males of a familiar phenotype. *Proceedings of the National Academy of Science*, 100(23), 13390–13395.
- Hollander, F. A., Van Overveld, T., Tokka, I., and Matthyssen, E. (2008). Personality and nest defence in the great tit (*Parus major*). *Ethology*, 114(4), 405–412.
- Houpt, K. A., Law, K., and Martinisi, V. (1978). Dominance hierarchies in domestic horses. *Applied Animal Ethology*, 4, 273-283.
- Kendal, R. L., Coolen, I., van Bergen, Y., and Laland, K. N. (2005). Tradeoffs in the adaptive use of social and asocial learning. *Advances in the Study of Behavior*, 35, 333-379.
- Kendrick, K. M., Haupt, M. A., Hinton, M. R., Broad, K. D., and Skinner, J. D. (2001). Sex differences in the influence of mothers on the sociosexual preferences of their offspring. *Hormones and Behavior*, 40(2), 322-338.
- Kortet, R., and Hedrick, A. (2007). A behavioural syndrome in the field cricket *Gryllus integer*: intrasexual aggression is correlated with activity in a novel environment. *Biological Journal of the Linnean Society*, 91(3), 475–482.
- Laland, K. N. (2004). Social learning strategies. *Learning and Behavior*, 32(1), 4-14.
- Laland, K. N., and Williams, K. (1997). Shoaling generates social learning of foraging information in guppies. *Animal Behaviour*, 53(6), 1161-1169.
- Lefebvre, L., and Giraldeau, L.A. (1994). Cultural transmission in pigeons is affected by the number of tutors and bystanders present. *Animal Behaviour*, 47(2), 331–337.
- Lefebvre, L., and Helder, R. (1997). Scrounger numbers and the inhibition of social learning in pigeons. *Behavioural Processes*, 40(3), 201-207.
- Maestripieri, D. (2003). Similarities in affiliation and aggression between cross-fostered rhesus macaque females and their biological mothers. *Developmental Psychobiology*, 43(4), 321-327.
- Malmkvist, J.B., and Hansen, S.W. (2002). Generalization of fear in farm mink, *Mustela vison*, genetically selected for behavior towards humans. *Animal Behaviour*, 64(3), 487-501.
- McDougall, P. T., Réale, D., Sol, D., and Reader, S. M. (2006). Wildlife conservation and animal temperament: causes and consequences of evolutionary change for captive, reintroduced, and wild populations. *Animal Conservation*, 9(1), 39–48.
- Mettler, A., and Shivik, J. (2007). Dominance and neophobia in coyote (*Canis latrans*) breeding pairs. *Applied Animal Behaviour Science*, 102(1-2), 85 – 94.
- Nicol, C. J. (1995). The social transmission of information and behaviour. *Applied Animal Behaviour Science*, 44(2-4), 79-98.
- Nicol, C. J. (2004). Development, direction, and damage limitation: Social learning in domestic fowl. *Learning and Behavior*, 32(1), 72-81.

- Nicol, C. J. (2006). How animals learn from each other. *Applied Animal Behaviour Science*, 100(1-2), 58-63.
- Nicol, C. J., and Pope, S. J. (1999). The effects of demonstrator social status and prior foraging success on social learning in laying hens. *Animal Behaviour*, 57(1), 1163-1171.
- Pajor, E. A., Kramer, D. L., and Fraser, D. (2000) Regulation of contact with offspring by domestic sows. Temporal patterns and individual variation. *Ethology*, 106(1), 37-51.
- Peake, T. M., and McGregor, P. K. (2004). Information and aggression in fishes. *Learning and Behavior*, 32(1), 114-121.
- Pellis, S. M., and McKenna, M. M. (1992). Intrinsic and extrinsic influences on play fighting in rats: effects of dominance, partner's playfulness, temperament and neonatal exposure to testosterone propionate. *Behavioural and Brain Research*, 50(1-2), 135-145.
- Réale, D., Reader, S. M., Sol, D., McDougall, P. T., and Dingemanse, N. J. (2007). Integrating animal temperament within ecology and evolution. *Biological Reviews*, 82(2), 291-318.
- Reaney, L. T., and Backwell, P. R. Y. (2007). Risk-taking behavior predicts aggression and mating success in a fiddler crab. *Behavioral Ecology*, 18(3), 521-525.
- Saetre, P., Strandberg, E., Sundgren, P.-E., Pettersson, U., Jazin, E., and Bergström, T. F. (2006). The genetic contribution to canine personality. *Genes, Brain and Behavior*, 5(3), 240-248.
- Sinn, D.L., Apiolaza, L. A., and Moltchanowskyz, A. (2006). Heritability and fitness-related consequences of squid personality traits. *Journal of Evolutionary Biology*, 19(5), 1437-1447.
- Smith, B. R., and Blumstein, D. T. (2008). Fitness consequences of personality: a meta-analysis. *Behavioral Ecology*, 19(2), 448-455.
- Smith, V. A., King, A. P., and West, M. J. (2002). The context of social learning: association patterns in a captive flock of brown-headed cowbirds. *Animal Behaviour*, 63(1), 23-35.
- Sundström, L. F., Petersson, E., Höjesjö, J., Johnsson, J. I., and Järvi, T. (2004). Hatchery selection promotes boldness in newly hatched brown trout (*Salmo trutta*): implications for dominance. *Behavioral Ecology*, 15(2), 192-198.
- Swaney, W., Kendal, J., Capon, H., Brown, C., and Laland, K. N. (2001). Familiarity facilitates social learning of foraging behaviour in the guppy. *Animal Behaviour*, 62(3), 591-598.
- Valsecchi, P., Choleris, E., Moles, A., Guo, C., and Mainardi, M. (1996). Kinship and familiarity as factors affecting social transfer of food preferences in adult Mongolian gerbils (*Meriones unguiculatus*). *Journal of Comparative Psychology*, 110(3), 243-251.
- Van Doorn, G. S., Hengeveld, G. M., and Weissing, F. J. (2003). The evolution of social dominance II: multi-player models. *Behaviour*, 140(10), 1333-1358.
- Weeks, J. W., Crowell-Davis, S. L., Caudle, A. B., and Heusner, G. L. (2000). Aggression and social spacing in light horse (*Equus caballus*) mares and foals. *Applied Animal Behaviour Science*, 68(4), 319-337.
- White, D. J. (2004). Influences of social learning on mate-choice decisions. *Learning and Behavior*, 32(1), 105-113.
- Wilson, D.S., Clark, A.B., Coleman, K., and Dearstyne, T. (1994). Shyness and boldness in humans and other animals. *Trends in Ecology and Evolution*, 9, 442-445.
- Witte, K., and Ryan, M. J. (2002). Mate choice copying in the sailfin molly, *Poecilia latipinna*, in the wild. *Animal Behaviour*, 63(5), 943-949.

Zentall, T. R. (2004). Action imitation in birds. *Learning and Behavior*, 32(1), 15-23.

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Chapter 11

**DEVELOPING THE SOCIAL SKILLS OF STUDENTS
WITH DISABILITIES THROUGH PEER TUTORING:
IMPLICATIONS FOR INCLUSION**

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ABSTRACT

Inclusion of students with disabilities in the ordinary school is one of the most powerful trends in contemporary special education worldwide; its success depends on a number of factors, such as social skills that constitute the focus of the specific chapter. Research indicates that students with disabilities often experience deficits in acquiring and using the necessary social skills to create and sustain positive interpersonal interactions. Social skills interventions can be delivered by students with disabilities themselves, by adult tutors or by peers; the contribution of the latter to the development of social skills will be further explored. Structured interactions with non-disabled peers are considered an effective approach to supporting students with disabilities learn and practice social skills needed for successful inclusion in the school, the community, and the workplace. The aim of this review is to extrapolate the best practices and to identify the major advantages and disadvantages of interventions based on peer tutoring. In order to familiarize the reader with the conceptual framework that the authors use, the chapter will begin with a consensus on the definition of social skills and an overview of the methods of their assessment. This will be followed by a review of peer-mediated interventions aiming at enhancing the social skills of students with various disabilities, such as autism spectrum disorders, behavioral problems, and learning disabilities, which constitute the main focus groups of published research. The chapter will conclude with a critical interpretation of the outcomes of peer-mediated social skills interventions for students with disabilities.

INTRODUCTION

1. Definition of Social Skills

Social interactions among people are prominent on many facets of everyday life, such as play, learning, and working; the basic components of social interactions are social skills, which encompass a variety of behaviors, such as helping, sharing, initiating and responding to communications by other people, asking for help from another person, or giving positive feedback to other people (Elliott, Malecki, and Demaray, 2001).

Social skills are defined in numerous ways by various researchers, but a distinction is commonly made between social competence and social skills. Social competence refers to the perceived quality of an individual's social interaction (Gresham, 1982), while social skills refer to discrete and goal-directed behaviors that are involved in successful interactions with others in a certain context (Sheridan and Walker, 1999). In order to develop an effective social profile, children are required not only to obtain the necessary social skills, but to use them also appropriately. However, it is important to realize and acknowledge that the way children behave depends not merely on the social skills that they possess, but also greatly from the feedback that they receive from their immediate environment. Therefore, the contextual framework in which social skills are exhibited should be taken into consideration (Haring, 1992).

The definition of social skills by Gresham and Elliott (1990) suggests that social skills constitute socially acceptable learned behaviors that provide the individual with the opportunity to engage in social interactions that result in positive rather than negative responses. The same researchers suggested that the acronym CARES – standing for cooperation, assertion, responsibility, empathy, and self-control – illustrates the five major social skills clusters that are possessed by skillful individuals and valued by parents and teachers. Elliot et al. (2001) made a very important note regarding the impact that social skills may have on achievement and compared it to the effect that drugs may have on the cognitive functioning of students with problems in attention; social skills cannot alter the cognitive capacity of the students, but they can help them use the knowledge that they already possess to demonstrate achievement.

There are two models that have been used to conceptualize social skills, the trait model and the molecular model. The trait model supports that social skills constitute an underlying personality characteristic, while the molecular model views social skills as specific and observable behavioral units that form the basis for the individual's general performance in a social context. McFall (1982) disagreed with both theories and suggested that social skills should be treated as specific abilities that allow the individual to perform adequately and appropriately at given social tasks.

Given the diversity in the definitions of social skills, it should be mentioned that the authors in the present chapter adopt the definition by Matson and Wilkins (2007) that social skills are interpersonal responses that have specific operational definitions and enable the child to adapt to the environment using both verbal and non-verbal communication.

Why are social skills important? It is imperative for students to develop adequate social skills (Merrell, 1993), since they are linked to high self-esteem (Boivin and Begin, 1989), respect from parents (Putallaz and Heflin, 1990), as well as generally high perceived quality

of life (Rubin, Booth, Rose-Krasnor, and Mills, 1995). Students who have deficits in the social skills area tend to experience a lot of adverse effects that are linked to the rejection of their peers and could lead even to clinical disorders (Parker and Asher, 1987). Poor academic performance and low scores on measures of emotional and cognitive development are also an outcome of poor social skills (Hubbard and Cole, 1994). Deficits in social skills can cause many adverse effects that may extend well beyond the academic domain (LaGreca and Stone, 1990) and last beyond the elementary and secondary school years (Gerber and Reiff, 1994).

Teachers expect their students to adhere to social norms in order to avoid risk for adverse school outcomes, such as poor academic performance, increased disciplinary problems, and inadequate interactions with peers (DiPerna and Elliott, 2000; O'Shaughnessy, Lane, Gresham, and Beebe-Frankenberger, 2002; Walker and Severson, 2002). Some researchers (e.g., Dwyer, Osher, and Warger, 1998) go even as far as claiming that social skills constitute important aspects of effective schools. There is evidence that students with and without disabilities have a difference as large as two standard deviations in their social skills functioning (Gresham, Elliott, and Black, 1987; Gresham and Reschly, 1987). Wentzel (1993) was among the first researchers to examine the relationship between indices of academic and students' social and academic behavior. The results showed that the performance of students in standardized achievement test scores was predicted by teachers' ratings of students' prosocial behavior through its relationship with academic behavior. Malecki and Elliott (2002) who extended the work of the former researcher using standardized measures collected by multiple informants (parents, teachers, and peers) also concluded that students' social skills have a predictive power over their academic outcomes. After looking at these studies, it can be concluded that prosocial behaviors impact academic achievement not only directly, but also indirectly through the enhancement of academic preparatory behaviors, such as listening to directions, remaining focused on a task, and asking clarifying questions (Elliot et al., 2001).

Despite the acknowledged contribution of social skills to a positive academic experience and environment, the majority of schools do not directly teach social skills and many students do not know what is expected of them in the social domain within the school setting (Meier, DiPerna, and Oster, 2006). For example, Gresham et al. (2000, as cited in Meier et al. 2006) discovered that the perceptions of teachers about the importance of social skills differ according to the grade that students attend, with teachers expecting more adaptive social skills from older students. Students who are able to cooperate and exert self-control are usually perceived by their teachers as being more able to succeed in school (Lane, Pierson, and Givner, 2003) and these skills are considered to be even more important for academic success than assertion skills. Some other skills that teachers consider to be essential for positive school outcomes are the following: appropriate and acceptable use of free time, good interpersonal relationship with people who are different, appropriate response to aggressive behavior and teasing by peers, and ability to follow directions (Lane, Givner, and Pierson, 2004; Meier et al., 2006). It is important to identify the social skills that teachers perceive as critical for classroom success in order to design positive behavior interventions to prevent or alter the disruptive behaviors of the students, as is required also from IDEA (2004). A good example of this approach that can be utilized to promote the positive behavior of students is set by Sugai and colleagues (2000), who used proactive instructional methods in order to teach students appropriate social behavior; reliable data on the social skills that teachers value can be used for the prioritization of the target social skills.

The ability to exhibit social competence is often more pressing for students who have significant difficulties, impairments or delays as pointed out by Gresham and MacMillan (1997). Actually, students with high-incidence disabilities (such as emotional disabilities, attention deficit/hyperactivity disorder, specific learning disabilities, and mental retardation – IDEA, 1997) have often been diagnosed on the basis of their social deficits (Gresham, MacMillan, and Siperstein, 1995). Kavanagh and Truss (1988) have claimed that: "Learning disabilities is a generic term that refers to a heterogeneous group of disorders manifested by significant difficulties in the acquisition and use of listening, speaking, reading, writing, reasoning, or mathematical abilities, or of social skills" (p. 550). However, since social problems are not officially included in the definition of learning disabilities, school districts are not obligated to assess the social skills of students. Therefore, most teachers are not likely to include reports of social skills deficits in their referrals, and so very few teachers have been assigned the task to address those deficits - even if they consider them critical to classroom management (Baum, Duffelmeyer, and Greenlan, 2001).

Despite the fact that some researchers argue as to whether social skill deficits should be included in the definition of learning disabilities (e.g., Forness and Kavale, 1991), many interventions designed for these students aim to help them overcome their social skill deficits. These deficits may occur either because a certain social skill has not been acquired and thus cannot be exhibited or because certain mediating factors (such as stress) may inhibit its acquisition and performance. Therefore, a number of social skills training programs have been designed to promote effective social functioning (Vaughn, 1985), which customarily address areas such as social problem solving, friendship, conversation, planning, and dealing with feelings. The overarching goal is to help students with disabilities develop effective social response patterns. Although most available social skills training programs have been based primarily on research conducted with typically developing students, a number of researchers suggested that the social skills that are considered to be important for peer acceptance may differ for students with disabilities (Nabuzoka and Smith, 1993; Roberts and Zubrick, 1992). Frederickson and Furnham (2004) went as far as arguing that the appropriateness of generic social skills training programs for promoting the social inclusion of students with disabilities should be viewed with caution and they claimed that the rejected notion of student subtypes should be reviewed.

Most researchers have realized that in order for social skills interventions to be effective, they need to include social agents who are influential on the behavior of children (Forness, San Miguel, and Kavale, 1996; Patterson, Reid, and Dishion, 1992). Apart from the parents, who are known to exert the greatest influence on their children, teachers and peers can also act as behavioral models. School constitutes a setting that is conducive to social learning, where students can acquire and practice their social, emotional and sociocognitive skills until they become socially competent. Peer-mediating instruction and interventions hold a prominent role among classroom-based interventions (Maheady, Harper, and Mallette, 1991; Utley, Mortweet, and Greenwood, 1997). They include a set of alternative teaching arrangements whereby peers act as instructional assistants either in a direct (e.g., tutoring) or in an indirect (e.g., modeling, encouraging) way, whereas the role of the teacher is primarily facilitative (Kalfus, 1984). Peer-mediated interventions may utilize some of the following components: direct instruction, coaching, modeling, rehearsal, shaping, prompting, and reinforcement of socially appropriate and acceptable behaviors (Gresham, 1981). Peers who are used as trainers facilitate the generalization of social skills and are very cost- and time-

effective, but caution must be exercised about their voluntary participation and their right to withdraw at any time (Matson, Nebel-Schwalck, and Matson, 2007).

2. Assessment of Social Skills

Why is it essential to assess social skills? For the following two basic reasons; to identify both generic and specific social skills deficits and to measure the effectiveness of proposed treatments (Sheridan and Walker, 1999). The main objectives of social skills interventions are to enhance the acquisition of social skills, to improve social skills performance, to minimize or extinct inappropriate or unwanted behaviors, and to promote the generalization and maintenance of social skills (Elliott et al., 1993). Most of these interventions are led either by adults or by peers who act as models and are based on the assertion that students learn social skills through observational and instrumental learning. The teachers who apply social skills interventions use similar methods to the ones that they employ in order to teach academic concepts (i.e., modeling of appropriate behavior, provision of corrective and constructive feedback) (Elliott and Gresham, 1991). The basic principles or training variables that seem to form the basis of all social skills interventions are instruction, rehearsal, reinforcement or feedback, and reductive processes (Ladd and Burgess, 1999). In order to evaluate whether the objectives set by the researchers have been met, assessments of social skills are used.

Sheridan and colleagues (1999) argued that the social skills of the students must be evaluated within the social contexts where they are exhibited, taking into account other contextual variables as well. They actually provided a list with the seven goals that all comprehensive assessments of social skills should aim for: a) conceptualize the skills and the behaviors that are essential in a meaningful and practical social context; b) specify which are the expectations, demands, and norms for behavior that exist within the given contextual frameworks where the child socializes; c) identify and evaluate the conditions or the variables that may cause, reinforce, impede, or differentiate a specific behavior within the examined environment; d) compare the child's skills, competencies, and deficits in relation to particularly important social behaviors; e) identify the purposes that certain behaviors serve in specific contexts; f) enhance the design and implementation of effective social skills interventions; and g) evaluate how useful are the outcomes of an intervention in terms of its applicability to diverse contexts for the recipient.

Elliott and Gresham (1987) proposed that a thorough assessment of a child's social skills should include ratings from and/ or interviews with parents, teachers, and peers; observations; behavioral role playing; and sociometrics. Sheridan et al. (1999) in their model referred to assessment of the child, of others, and of the social context. Despite the wide range of assessment methods that have been proposed by specialists, most researchers still choose to use behavior rating scales, either because they provide more data faster and cheaper or because they provide access to multiple informants simultaneously (Elliott, Busse, and Gresham, 1993). The behavior rating scales usually require from informants to assess students on a number of given criteria that often allow for comparison with same-aged norm groups. Potential problems could be caused either by reporting biases or by depression (Youngstrom, Izard, and Ackerman, 1999; Youngstrom, Loeber, and Stouthamer-Loeber, 2000). Therefore, it is recommended to supplement behavior rating scales with direct observations or follow-up interventions, mainly in order to identify the social skills deficits that need to be urgently

addressed (Ruffalo and Elliott, 1997). The main limitation of the behavior rating scales is that they are not sensitive enough to small changes in behavior that occur over time. In order to overcome this major limitation, goal attainment scaling could be used.

Children themselves are often asked to provide self-reports on their social skills that derive from subjective evaluations of their own social behaviors and relationships or from their hypothetical reactions to given social scenarios (Warnes, Sheridan, Geske, and Warnes, 2005). The strengths of children's self-reports are that they are generally easy to administer in a variety of settings without having to spend a lot of money (Beitchman and Corradini, 1988) and that they can provide information about the way students perceive and process stimuli. Direct observations of the child's behavior usually provide information about the frequency, duration, or range of social behaviors; however, the rationale behind those behaviors remains under explored (Warnes et al., 2005).

Peers, which constitute the main interest of this chapter, can be used also to assess the social skills of students with disabilities (Wright and Torrey, 2001). Although sociometric assessment and peer assessment are two different techniques, they fall within the broader area of peer-referenced assessment. As pointed out by Gresham and Stuart (1992):

Peer-referenced assessment has one salient element: The information provided is collected from a child's peers. Unlike tests, behavior rating scales, direct observations, or role-play measures, peer-referenced assessments are based on data collected from a relatively large number of persons. These data, in turn, are averaged, weighted, and/or transformed to calculate scores along various dimensions of sociometric status or social functioning. Information provided by peers cannot be obtained from other sources and therefore represents unique and potentially valuable data regarding a child's social competence. (p. 224).

Sociometric assessment, which is used to measure the attraction, roles, behaviors, or traits of specific individuals, has been very popular for some decades. It employs mainly a Peer-Nomination Technique (PNT) that was standardized by Coie, Dodge, and Coppotelli in 1982. According to this technique, children are requested to nominate their most- and least-liked peers; on the basis of this nomination indices of social preference and social impact are extracted, which are then further processed in order to assign membership to one of the following 5 categories: popular, accepted, rejected, neglected, and controversial. This is the standard approach that is usually employed in order to measure social competence according to sociometric assessment.

Peer assessment, on the other hand, uses various measures across different studies and some are used only for the purpose of a specific study. The measure that has been more consistently used was developed in 1976 by Pekarik, Prinz, Liebert, Weintraub, and Neale and is called Pupil Evaluation Inventory (PEI). Although it was constructed to evaluate the social adjustment of children at risk for psychopathology, it has been used subsequently with children with disabilities (e.g. Johnston and Pelham, 1986). Wright and Torrey (2001) examined the relationship between the two peer-referenced measures (PNT and PEI) and parent and teacher ratings of social skills and problem behaviors of children and concluded that the correlation between them was satisfactory.

Terry (2000) exemplified the difficulties that are inherent in using limited nomination measures, especially in order to collect assessment data on students with disabilities who are integrating onto mainstream classes (Frederickson and Furnham, 1998a). For example,

Taylor, Asher, and Williams (1987) found that many of the students who were classified as rejected using a restricted nomination procedure were chosen by several others when the nomination measures that were employed were unrestricted. Frederickson and Furnham (2004) reported also that similar difficulties can be encountered when using more general sociometric preference criteria (e.g., 'Name three children you like best') rather than activity-specific criteria (e.g., 'Which children do you like to play with/work with?'). Frederickson and Furnham (1998b) discovered that although more included students with mild learning disabilities were rated as popular when a play as opposed to a work criterion was used, the proportion of the rejected sample remained the same. The evidence that has been presented to this point seems to suggest that students do not apply a general 'liking' criterion regardless of the sociometric question that is asked; on the contrary, they tend to classify their included peers differentially on the basis of desired affiliation and avoidance for work and play activities.

3. Peer-Mediated Interventions for Social Skills

There are three types of peer-mediated interventions for social skills according to Odom and Strain (1984); namely, proximity, prompt/reinforce, and peer initiations. *Proximity* interventions draw on the natural social interactions that take place between children with social skills deficits and their typically developing peers. Wolfberg and Schuler (1993) paired children with autism with more socially competent peers and this made children with autism engage in more social play. *Prompt/reinforce* interventions aim at teaching typically developing peers to use prompts and social reinforcers in order to enhance the positive social behaviors of their peers with disabilities. This method has been proven effective in decreasing negative social interactions (Ervin, Miller, and Friman, 1996), inappropriate use of language (Northup et al., 1995), and off-task behaviors (Lewis and Sugai, 1996). *Peer-initiated* strategies ask from typically developing children to carry a disproportionate share of responsibility for initiating a social exchange with a peer with disabilities. This approach is also effective in enhancing the appropriate social interactions of children with disabilities (Goldstein, Kaczmarek, Pennington, and Shafer, 1992). Kamps, Barbeta, Leoneard, and Delquadri (1994) extended the latter intervention by instructing typically developing children to teach specific social skills to small groups of classmates or peers with disabilities.

Most peer-mediated interventions for social skills have been carried out with young children and using mainly students without disabilities as the agents of change (Cartledge and Millburn, 1995). Blake, Wang, Cartledge, and Gardner (2000) used adolescents with serious emotional disturbances as peer mediators and concluded that the outcome of the intervention was the desired one and that this experience was beneficial to peer trainers and student trainees alike. It should also be highlighted that most studies have focused mainly on the verbal social skills of children with disabilities, while minimum attention has been paid to non-verbal social skills that have been found problematic in children with disabilities. For example, Agalotis and Kalyva (2008) reported that young children with learning disabilities exhibit significantly fewer nonverbal social interactions than their typically developing peers. Therefore, it is suggested to undertake more future research in the area of training and improving the non-verbal social interaction skills of children with disabilities.

In the remaining of this section the authors will review published research on peer-mediated interventions for children with autism, emotional-behavioral disabilities, and learning disabilities. Peer-led interventions for social skills have been employed mainly with children with autism, whereas for the other two groups of children with disabilities peer tutoring has been used mainly for academic purposes and not for addressing their social skills deficits.

3.1. Peer-Mediated Interventions and Autism

Autism is a disorder characterized by marked difficulties in the area of social skills and communication (American Psychological Association, 1994). Many children with autism experience difficulties in using spontaneous language and play, in initiating and maintaining conversations, as well as in processing social messages and responding appropriately to social cues and situations (Dalrymple, 1992). Children with autism must often be taught how to initiate and maintain a conversation, how to take the perspective of others, and how to engage in pretend play. However, social skills are often left out from Individualized Education Plans that emphasize mainly the acquisition of academic-related skills (Scattone, 2007). Since it is very important for the specific population to overcome these difficulties, it is suggested that specific training and practice opportunities can be used to improve the social interactions of children with autism over time (Gonzalez-Lopez and Kamps, 1997).

A number of interventions have been proposed and implemented that seem to have the desired outcomes: time-out strategies and the constructive use of student preferences (Charlop and Trasowech, 1991), social scenarios or written cues to enhance social interaction (Krantz and McClannahan, 1998), and priming with peers to increase social initiations and responses (Zanolli, Daggett, and Adams, 1996; Kalyva and Avramidis, 2005). Most social skills interventions that were introduced initially aimed at improving basic interpersonal skills, such as establishing eye contact or orienting toward another person (Lovaas, 1987). Matson et al. (2007) in their review support that most studies aiming at enhancing the social skills of children with autism focus on eye contact, appropriate content and intonation of speech, initiation and maintenance of play and other relevant skills. Most recent interventions have addressed play skills, perspective-taking, or conversation skills with the aid of naturalistic procedures (Pierce and Schreibman, 1997), music (Brownell, 2002), and videos (Nikopoulos and Keenan, 2004). The encouraging findings for some interventions is that they could be generalized to other settings (Koegel, Koegel, Hurley, and Frea, 1992) or to other people who were not involved in the process (Kalyva et al., 2005; Pierce et al., 1997) and so they helped children with autism become more independent and able to rely on themselves (Apple, Billingsley, and Schurtz, 2005).

The focus of the specific chapter is on peer-mediation interventions, which form the largest and most empirically supported kind of social intervention recommended for children with autism (Bass and Mulick, 2007). The use of peers as intervention agents constituted an attempt to overcome the limitations posed by interventions that are led by adults and are highly structured, resulting thus to restricted independence and limited generalization (Strain, Kohler, and Goldstein, 1996). Peers who become active parts of social skills interventions facilitate the generalization process (Kalyva et al., 2005) and so it is not required to spend extra time and effort to transfer the acquired skills of children with autism to more naturalistic settings (Rogers, 2000). Strain and his colleagues were pioneers in setting the framework for a training protocol to teach typically developing children how to make certain offers to their

classmates with autism (Strain and Odom, 1986). Typically developing peers usually role-play with adults the strategies that they are prompted to use with children with autism using appropriate play materials and activities (Strain, 1987). Actually, the initial training process was slightly modified shortly after, since the typically developing children were trained to interact with adults who were exhibiting self-stimulatory and avoidance behaviors that characterize the behavior of children with autism (Ragland, Kerr, and Strain, 1978). The responses of children with autism to the efforts of their typically developing peers to engage them in social interactions varied according to their behavior at baseline. More specifically, children with autism who exhibited more positive social behaviors at the beginning of the intervention benefited from it more, since they were more responsive (Strain, Shores, and Timm, 1977). Despite the undisputable success of these interventions, they can be quite complex, since the typically developing peers who take part must have advanced social skills and not all schools have the required specialized personnel to train the typically developing children and monitor the progress of children with autism (Bass et al., 2007).

Although it is beyond dispute that peer-mediated approaches are the most effective in improving the social skills of children with autism, a lot of work needs to be done before the optimal intervention can be identified. Some promising interventions that are still in the initial stage are the integrated play group, the peer buddy, and the group oriented contingencies, which will be presented in more detail.

The *Integrated Play Group (IPG)* approach that can be defined as peer mediation facilitated by adults, aims to intervene in the physical arrangement of the environment in an attempt to create and enhance mutually enjoyable social interaction, communication, play, and imagination experiences between children with autism and their typically developing peers (Wolfberg and Schuler, 1999). Children with autism can develop more fully if they engage in structured play activities with developmentally more advanced peers, while becoming simultaneously more motivated to partake in social and play interactions. This process can be equally beneficial to typically developing children who learn to accept and socialise with children who behave in a different and occasionally more challenging way (Kalyva, 2005). The play groups that are created are usually small and comprise of children of diverse academic, intellectual, and interactive abilities, while an adult guides and facilitates the play. Typically developing children are taught many skills, such as getting someone's attention, sharing, requesting, organizing games, and paying compliments, in order to interact independently with the target children with autism. The IPG model has succeeded in doubling the amount of interaction with peers involving "common focus" on an activity, decreasing thus the stereotypic and inappropriate behaviors of children with autism (Wolfberg and Schuler, 1993). It is important to underline that the behavioral gains were no longer evident even after the withdrawal of the intervention, meaning that adult support was an essential part of the intervention and it should be maintained for a sufficient period of time.

The "*peer buddy*" intervention is in principle an active peer tutor training program, whereby a child with autism is assigned to a typically developing peer "buddy", who is taught to talk to, play with, and interact with the child with autism (English, Goldstein, Shafer, and Kaczmarek, 1997; English, Goldstein, Kaczmarek, and Shafer, 1996). In comparison to a more passive intervention, this approach leads to increased and more appropriate social interactions between children with and without disabilities (English et al., 1997). Children with autism acquired more elaborate play skills (i.e., asking for an object) and spent more time in social interaction with peers (Laushey and Heflin, 2000).

The third approach, *the group oriented contingencies*, requires that all the children who attend a classroom exhibit a specified behavior before any child is reinforced. The rationale is that untrained supportive behaviors are encouraged in the hope that each child influences one another's performance. Kohler et al. (1995) trained preschool-aged children with autism and their typically developing peers to remind one another to use the skills they had previously acquired and some increases were recorded in the amount of time children with autism and peers spent in social interaction (Lefebvre and Strain, 1989).

Another group of peers that could enhance the social skills of children with autism is typically developing siblings, who have been used in a few studies that were conducted in the home setting (Strain and Danko, 1995). After the implementation of an intervention that included adult prompting, edible reinforcement, and self-monitoring of social behaviors without adult reinforcement, it was found that children with autism engaged in more positive social interactions with their typically developing siblings (Strain, Kohler, Storey, and Danko, 1994). This was largely due to the fact that typical siblings were instructed to promote play and play-related speech, to praise play behaviors, and to prompt their siblings with autism to respond to initiations, with skills being generalized and maintained after withdrawing intervention (Belchic and Harris, 1994; Celiberti and Harris, 1993). The incorporation of the ritualistic and repetitive behaviors of children with autism into several games has enhanced joint attention and social play interactions with siblings (Baker, 2000).

Summarising, in peer-led interventions, classmates are used to model and ultimately improve the social behaviors of children with autism. Research has shown that structured play groups and guided modeling of social skills can have positive effects on the social behaviors of children with autism in peer-inclusive settings (Odom, McConnell, and McEvoy, 1992; Pierce and Schreibman, 1995, 1997), while improvement was evident also in appropriate behavior within the school setting in general, such as during the lunch or in the playground (Haring and Breen, 1992; Kamps, Potucek, Lopez, Kravits, and Kemmerer, 1997). Another promising intervention that is used to increase desirable social behaviors like completion of assigned tasks and academic accuracy is peer-monitoring (Kohler, Schwartz, Cross, and Fowler, 1989; Morrison, Kamps, Garcia, and Parker, 2001; Sainato, Goldstein, and Strain, 1992; Shearer, Kohler, Buchan, and McCullough, 1996). Peer-monitoring strategies ask from peers to model initially a target behavior that they then prompt the students with disabilities to engage in and finally to award them points for engaging in the desired target behavior (Kohler et al., 1989; Rhode, Morgan, and Young, 1983).

3.2. Peer-Mediated Interventions and Emotional-Behavioral Disabilities

Children suffering from emotional and behavioral disabilities often experience problems in their interpersonal and social interactions with their peers (Epstein, Kauffman, and Culligan, 1985; Friedman et al., 1988; Kern et al., 1995) that are exacerbated by both academic and behavioral deficits (Kauffman, 2005). Social skills deficits in students with emotional-behavioral problems play a very important role in their successful integration into the academic environment (Desbiens et al., 2003), since they do not seem to possess the necessary social skills to be accepted in the school setting and they are usually characterized as 'socially incompetent' by their teachers and peers (Gresham, 1982). Research has confirmed the popular notion that students with emotional-behavioral disabilities are the least popular in their classrooms (Sabornie, 1987; Sabornie and Kauffman, 1985).

Students with emotional-behavioral disabilities face difficulties when trying to interact with other people, which in combination with their unpredictable and often aggressive behavior, create conflict with their peers and can lead even to rejection (Coie, Terry, Zakriski, and Lochman, 1995). This forms a vicious circle, since rejection by their peers exacerbates their mistrust and sadness and maximizes their social isolation and exclusion. When students with emotional-behavioral disabilities experience this rejection, which limits their choice of friends, they opt to befriend other students who experience similar emotional-behavioral difficulties (Dishion, French, and Patterson, 1995; Farmer and Hollowell, 1994). These friendships, however, tend to nurture maladjusted social behaviors that are habitually manifested as aggression and form the precedent of later antisocial behavior (Dishion, 1991; Farmer and Farmer, 1996; Patterson, 1993).

These problems that students with emotional-behavioral disabilities face in creating and preserving positive interactions with peers and adults caused the inclusion of social skills programs within the school setting, which aim at exerting a positive influence on these children (Cartledge and Millburn, 1995; Royer, 1995; Stephens, 1992). Most of these programmes, which train students with emotional-behavioral disabilities to control their emotions, to adopt problem-solving strategies, and to acquire socio-cognitive skills, have often limited effectiveness (Beelmann, Pfungsten, and Losel, 1994; Kavale, Marthur, Forness, Rutherford, and Quinn, 1997) and are not generalized to other settings (Royer, Bitandau, Desbiedns, Maltais, and Gagnon, 1997). However, Franca, Kerr, Reitz, and Lambert (1990) found that peer-mediated interventions can have a positive effect on the peer interactions of children with emotional and behavioral problems. Moreover, Spencer, Scruggs, and Mastropieri (2003) reported that children attending peer tutoring performed better on social studies tests than children following traditional instruction. Locke and Fuchs (1995) noted that children made more positive peer-to-peer comments during the implementation of peer tutoring. Peer-mediated interventions outside social skills workshops, which build on the social ties between children and assume that learning takes place through observation, have also been studied. The social interaction with peers outside the structured classroom setting can help students with emotional-behavioral disabilities practice and establish their social skills (Odom and Strain, 1984).

Although research has demonstrated that cooperative learning and peer tutoring are recognized as means of improving the academic performance of students with emotional-behavioral disabilities, the effectiveness of peer-mediated interventions for social skills has not been equally established (Desbiens and Royer, 2003). For example, Bierman, Miller, and Stabbs (1987) and Lochman, Coie, Underwood, and Terry (1993) have found that students with emotional-behavioral disabilities will remain stigmatized and will receive negative sociometric classifications despite any positive changes in their social behaviour. This stream of research suggests that peers continue to view in a negative light those students who have a socially inappropriate image and reputation, even if the latter start behaving in more socially acceptable manners (Bowen et al., 2000; Wass, 1988).

3.3. Peer-Mediated Interventions and Learning Disabilities

Students with learning disabilities, which constitute a mild form of disabilities (Mastropieri and Scruggs, 2000), often exhibit problems not only in their academic performance but also in their interpersonal social skills. It is estimated that roughly 38%-75% of the 2,800,000 students with learning disabilities in the US experience deficits in their social

skills (Baum et al., 2001; Kavale and Forness, 1995). They may face problems in their daily social interactions with their classmates (Rivera and Smith, 1997; Wood, 1998). Moreover, their tendency to behave inappropriately in the classroom by disrupting the lesson verbally or nonverbally, by not complying with the rules, or by not engaging in predefined activities can render them even less popular among their peer group (DePaepe, Shores, and Jack, 1996; Gunter, Denny, Jack, and Shores, 1993).

Students with learning disabilities encounter many difficulties in the way that they perceive themselves in social interactions, in the degree to which others view them as socially competent, in the extent to which they are perceived to act effectively in social interactions, as well as the way that they behave in social situations (Bryan, 1991). These difficulties - that have been found to cover an array of domains, such as social cognition (Maheady and Sainato, 1986), social relationships (Pearl, Donahue, and Bryan, 1986), and communicative competence (Donahue, Peart, and Bryan, 1983) - affect approximately 75% of students with learning disabilities (Kavale and Forness, 1995). The level to which these students are reported to display social skills deficits differs according to the source of evaluation (teachers, peers, and students with SLD themselves) and to the type of social skill deficit that is assessed. Although the existence of problems in the social arena has been documented, a lot of research needs to be done on the role that cognition, language, memory, and perception play in defining the association between social skills and learning disabilities (Kavale and Mostert, 2004). However, most literature on peer-led or peer-mediated interventions with this population has focused mainly on the acquisition of academic-related skills through peer-teaching strategies such as ClassWide Peer Tutoring (CWPT; Greenwood, Delquadri, and Carta, 1999), ClassWide Student Tutoring Teams (CSTT; Maheady, Harper, and Mallette, 1991), and Peer-Assisted Learning Strategies (PALS; Fuchs, Fuchs, Phillips, and Karns, 1994). Therefore, it is encouraging that emerging research identifies and values the role of social skill deficits in the core construct of learning disabilities (Sridhar and Vaughn, 2001; Vaughn, LaGreen, and Kuttler, 1999).

CONCLUSION

The efficacy of peer-mediated interventions on the social skills of students with disabilities is questionable, due to a number of issues that pertain to social skills training in general. It is still not clear whether the social skills deficits manifested by students with disabilities can be remediated and the gains generalized to other social contexts or whether different observers place equal value on the effectiveness of social skills training. The quite limited success of peer-mediated interventions may be due to their actual nature, since most of the studies that have been reviewed so far have employed a training that was designed to meet specific needs within a given social framework. Moreover, many interventions have been applied for a rather limited amount of time that did not suffice to produce really significant and long-lasting changes in the social skills of students with disabilities. Additionally, a lot of social skills research studies have employed social skills interventions without paying enough attention to the etiology of social skills deficits; this resulted largely to the treatment of the symptoms and not the underlying causes of social skills deficits.

Issues with the definition and assessment of social skills that were underlined in the first sections of the present chapter have further undermined the evaluation of the effectiveness of most studies that have been reviewed so far. Therefore, Bryan (2005) argued that social skills interventions have not been particularly successful in changing the social status (peer acceptance) of students with disabilities due to the above mentioned methodological limitations (e.g., training behaviors not related to the cause of rejection). However, certain types of social interventions (i.e. those targeting affect and self-perceptions, such as attributions and locus of control), have been shown to have more positive effects.

In order to yield more significant findings, it is essential to expand research to eco-cultural models that recognize the role that significant others play in the development of the individual child. The focus of eco-cultural research is on the interplay between characteristics of the individual, family, school, and community. Bryan (2005) claimed that the eco-cultural perspective is embedded in the family-centred research that dominates the fields of early childhood special education, research on risk and resilience (Wong, 2003), as well as studies of the peer group membership of students with learning disabilities (Pearl, 2002; Wiener and Schneider, 2002).

Another point that needs to be highlighted is that despite the acknowledgement of the importance of social skills, not enough emphasis has been placed on their instruction. Even the No Child Left Behind Act of 2001 (which constitutes the most recent attempt of school reform in the US) demanded that science-based instructional strategies be implemented in order to ensure that students meet the standards set forth in content curricula and left out the social domain. Since inclusion cannot be complete without social inclusion, peer-mediated social skills training should be part of the curriculum, since they seem to benefit both students with disabilities and their typically developing peers.

REFERENCES

- Agaliotis, I., and Kalyva, E. (2008). Nonverbal social interaction skills of children with learning disabilities. *Research in Developmental Disabilities, 28*, 1-11.
- American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed). Washington, DC: Author.
- Apple, A. L., Billingsley, F., and Schwartz, I. S. (2005). Effects of video modeling alone and with self-management on compliant-giving behavior of children with high-functioning autism spectrum disorders. *Journal of Positive Behavior Interventions, 7*, 33-46.
- Baker, M. J. (2000). Incorporating the thematic ritualistic behaviors of children with autism into games: Increasing social play interactions with siblings. *Journal of Positive Behavior Interventions, 2*, 66-84.
- Bass, J. D., and Mulick, J. A. (2007). Social play skills enhancement of children with autism using peers and siblings as therapists. *Psychology in the Schools, 44*, 727-735.
- Baum, D. D., Duffelmeyer, F., and Greenlan, M. (2001). Resource teacher perceptions of the prevalence of social dysfunction among students with learning disabilities. *Journal of Learning Disabilities, 21*, 380-381.

- Beelmann, A., Pfingsten, U., and Losel, F. (1994). Effects of training social competence in children: A meta-analysis of recent evaluation studies. *Journal of Clinical Child Psychology, 23*, 260–71.
- Beitchman, J. H., and Corradini, A. (1988). Self-report measures for use with children: A review and a comment. *Journal of Clinical Psychology, 44*, 477-490.
- Belchic, J. K., and Harris, S. L. (1994). The use of multiple peer exemplars to enhance the generalization of play skills to the siblings of children with autism. *Child and Family Behavior Therapy, 16*, 1–25.
- Bierman, K. L., Miller, C. L., and Stabb, S. D. (1987). Improving the social behavior and peer acceptance of rejected boys: Effects of social skill training with instructions and prohibitions. *Journal of Consulting and Clinical Psychology, 55*, 194–200.
- Blake, c., Wang, W., Cartledge, G., and Gardner, R. (2000). Middle school students with serious emotional disturbances serve as social skills trainers and reinforcers for peers with SED. *Behavioral Disorders, 25*, 280-298.
- Boivin, M., and Begin, G. (1989). Peer status and self-perception among early elementary school children: The case of rejecting children. *Child Development, 10*, 601-610.
- Brownell, M. D. (2002). Musically adapted Social Stories to modify behaviors in students with autism: Four case studies. *Journal of Music Therapy, 2*, 117–144.
- Bryan, T. (2005). Science-based advances in the social domain of learning disabilities. *Learning Disability Quarterly, 28*, 119-121.
- Bryan, T. H. (1991). Social problems and learning disabilities. In B.Y.L. Wong (Ed.), *Learning about learning disabilities* (pp. 195- 231). New York: Academic Press.
- Cartledge, G., and Millburn, J. F. (1995). *Teaching social skills to children and youth: Innovative approaches* (3rd ed). Boston, MA: Allyn and Bacon.
- Celiberti, D. A., and Harris, S. L. (1993). Behavioral intervention for siblings of children with autism: A focus on skills to enhance play. *Behavior Therapy, 24*, 573–599.
- Charlop, M. H., and Trasowech, I. (1991). Increasing autistic children’s daily spontaneous speech. *Journal of Applied Behavior Analysis, 24*, 747-761.
- Coie, J. D., Terry, R., Zakriski, A., and Lochman, J. (1995). Early adolescent social influences in delinquent behaviour. In J. McCord (Ed.), *Coercion and punishment in long-term perspectives*. Cambridge: Cambridge University Press.
- Coie, J.D., Dodge, K. A., and Coppotelli, H. (1982). Dimensions and types of social status: A crossage perspective. *Developmental Psychology, 18*, 557–570.
- Darlymple, N. (1992). *Some interpersonal social skill objectives and teaching strategies for people with autism*. University of Indiana Press.
- DePaepe, P. A., Shores, R. E., and Jack, S. L. (1996). Effects of task difficulty on the disruptive and on-task behavior of students with severe behavior disorders. *Behavioral Disorders, 21*, 216-225.
- Desbiens, N., and Royer, E. (2003). Peer groups and behaviour problems. *Emotional and Behavioural Difficulties, 8*, 120-139.
- DiPerna, J. C., and Elliott, S. N. (2000). *ACES: The Academic Competence Evaluation Scales*. San Antonio, TX: Psychological Corporation.
- Dishion, T. J. (1991). Family, school, and behavioral antecedents to early adolescent involvement with antisocial peers. *Developmental Psychology, 27*, 172–80.

- Dishion, T. J., French, D. C., and Patterson, G. R. (1995). The development and ecology of antisocial behaviour. In D. Cicchetti and D. J. Cohen (Eds.), *Development and psychopathology*, vol. 2. New York: Wiley.
- Donahue, M., Pearl, R., and Bryan, T. (1983). Communicative competence in learning disabled children. In I. Bialer and K. Gadow (Eds.), *Advances in learning and behavioral disabilities* (Vol. 2, pp. 49-84). Greenwich, CT: JAI Press.
- Dwyer, K., Osher, D., and Warger, C. (1998). *Early warning, timely response: A guide to safe schools*. Washington, DC: U.S. Department of Education.
- Elliott, S. N., and Gresham, F. M. (1987). Children's social skills: Assessment and classification practices. *Journal of Counseling and Development*, 66, 96-99.
- Elliott, S. N., and Gresham, F. M. (1991). *Social skills intervention guide*. Circle Pines, MN: American Guidance Service.
- Elliott, S. N., Busse, R. T., and Gresham, F. M. (1993). Behavior rating scales: Issues of use and development. *School Psychology Review*, 22, 313-321.
- Elliott, S. N., Malecki, C. K., and Demaray, M. K. (2001). New directions in social skills assessment and intervention for elementary and middle school students. *Exceptionality*, 9, 19-32.
- English, K., Goldstein, H., Kaczmarek, L., and Shafer, K. (1996). "Buddy skills" for preschoolers. *Teaching Exceptional Children*, 28, 62-66.
- English, K., Goldstein, H., Shafer, K., and Kaczmarek, L. (1997). Promoting interactions among preschoolers with and without disabilities: Effects of a buddy skills training program. *Exceptional Children*, 63, 229-243.
- Epstein, M. H., Kauffman, J. M., and Cullinan, D. (1985). Patterns of maladjustment among the behaviorally disordered II: Boys aged 6-11, boys aged 12-18, girls aged 6-11, and girls aged 12-18. *Behavioral Disorders*, 10, 125-135.
- Ervin, R. A., Miller, P. M., and Friman, P. C. (1996). Feed the hungry bee: Using positive peer reports to improve the social interactions and acceptance of a socially rejected girl in residential care. *Journal of Applied Behavior Analysis*, 29, 251-253.
- Farmer, T. M., and Hollowell, J. H. (1994). Social networks in mainstream classrooms: Social affiliations and behavioral characteristics of students with EBD. *Journal of Emotional and Behavioral Disorders*, 2, 143-55.
- Farmer, T. W., and Farmer, E. M. Z. (1996). Social relationships of students with exceptionalities in mainstream classrooms: Social networks and homophily. *Exceptional Children*, 62, 431-50.
- Forness, S. R., and Kavale, K. A. (1991). Social skills deficits as a primary learning disability: A note on problems with the ICLD diagnostic criteria. *Learning Disabilities Research and Practice*, 6, 44-49.
- Forness, S. R., San Miguel, S. K., and Kavale, K. A. (1996). Social skill deficits in learning disabilities: The psychiatric comorbidity hypothesis. *Learning Disability Quarterly*, 19, 252-261.
- Franca, V. M., Kerr, M. M., Reitz, A. L., and Lambert, D. (1990). Peer tutoring among behaviorally disordered students: Academic and social benefits to tutor and tutee. *Education and Treatment of Children*, 13, 109-128.
- Frederickson, N. L., and Furnham, A. F. (1998a). Use of sociometric techniques to assess the social status of mainstreamed children with learning difficulties. *Genetic, Social and General Psychology Monographs*, 124, 381-433.

- Frederickson, N. L., and Furnham, A. F. (1998b). Sociometric status group classification of included children who have moderate learning difficulties: An investigation of personal and environmental factors. *Journal of Educational Psychology, 90*, 772–783.
- Frederickson, N. L., and Furnham, A. F. (2004). Peer-assessed behavioural characteristics and sociometric rejection: Differences between pupils who have moderate learning difficulties and their mainstream peers. *British Journal of Educational Psychology, 74*, 391–410.
- Friedman, R. M., Silver, S. E., Duchnowski, A. J., Kutash, K., Eisen, M., Brandenburg, N. A., and Prange, M. (1988). Characteristics of children with serious emotional disturbances identified by public systems as requiring services. Tampa, FL: Florida Mental Health Institute, University of South Florida.
- Fuchs, L. S., Fuchs, D., Phillips, N., and Karns, K. (1994). *Peer-mediated mathematics instruction: A manual*. Nashville, TN: Vanderbilt University, Peabody College.
- Gerber, P. J., and Reiff, H. B. (1994). *Learning disabilities in adulthood: Persisting problems and evolving issues*. Boston: Andover Medical Publishers.
- Goldstein, H., Kaczmarek, L., Pennington, R., and Shafer, K. (1992). Peer-mediated intervention: Attending to, commenting on, and acknowledging the behavior of preschoolers with autism. *Journal of Applied Behavior Analysis, 25*, 289–305.
- Gonzalez-Lopez, A., and Kamps, D. (1997). Social skills training to increase social interactions between children with autism and their typical peers. *Focus on Autism and Other Developmental Disabilities, 12*, 2–14.
- Greenwood, C. R., Delquadri, J. C., and Carta, J. J. (1999). *ClassWide Peer Tutoring (CWPT) for teachers*. Longmont, CO: Sopris West.
- Gresham, F. M. (1981). Social skills training with handicapped children: A review. *Review of Educational Research, 51*, 139–176.
- Gresham, F. M. (1982). Misguided mainstreaming: The case for social skills training with handicapped children. *Exceptional Children, 48*, 422–433.
- Gresham, F. M., and Elliott, S. N. (1990). *Social skills rating system*. Circle Pines, MN: American Guidance Service.
- Gresham, F. M., and MacMillan, D. L. (1997). Social competence and affective characteristics of students with mild disabilities. *Review of Educational Research, 67*, 377–415.
- Gresham, F. M., and Reschly, D. J. (1987). Sociometric differences between mildly handicapped and nonhandicapped Black and White students. *Journal of Educational Psychology, 79*, 195–197.
- Gresham, F. M., and Stuart, D. (1992). Stability of sociometric assessment: Implications for uses as selection and outcome measures in social skills training. *Journal of School Psychology, 30*, 223–231.
- Gresham, F. M., Elliott, S. N., and Black, F. L. (1987). Social skills comparisons across diagnostic subgroups of children. *School Psychology Review, 16*, 78–88.
- Gresham, F. M., Sugai, G., and Horner, R. H. (1996). Interpreting outcomes of social skills training for students with high-incidence disabilities. *Exceptional Children, 67*, 331–344.
- Gunter, P. L., Denny, R. K., Jack, S. L., Shores, R. E., and Nelson, C. M. (1993). Aversive stimuli in academic interactions between students with serious emotional disturbance and their teachers. *Behavioral Disorders, 18*, 265–274.

- Haring, N. (1992). The context of social competence: Relations, relationships, and generalization. In S. Odom, S. McConnell, and M. McEvoy (Eds.), *Social competence of young children with disabilities: Issues and strategies for intervention* (pp. 307–320). Baltimore: Brookes.
- Haring, T. G., and Breen, C. B. (1992). A peer-mediated social network intervention to enhance the social integration of persons with moderate and severe disabilities. *Journal of Applied Behavior Analysis, 25*, 319-333.
- Individuals with Disabilities Education Act Amendments of 1997, Public Law 105–17, 20 U.S.C. Chapter 33, Section 1415 et seq. (EDLAW, 1997).
- Johnston, C., and Pelham, W. E. (1986). Teacher ratings predict peer ratings of aggression at 3-year follow-up in boys with attention deficit disorder with hyperactivity. *Journal of Consulting and Clinical Psychology, 54*, 571-572.
- Kalfus, G. R. (1984). Peer-mediated instruction: A critical review. *Child Development and Family Behavior Therapy, 6*, 17--43.
- Kalyva, E. (2005). *Aftismos: Ekpedeftikes ke therapeftikes prosegisis* [Autism: Educational and therapeutic approaches]. Athens: Papazisis.
- Kalyva, E., and Avramidis, E. (2005). Improving communication between children with autism and their peers through the “circle of friends”: A small-scale intervention study. *Journal of Applied Research in Intellectual Disabilities, 18*, 253-261.
- Kamps, D. M., Barbetta, P. M., Leonard, B. R., and Delquadri, J. C. (1994). ClassWide Peer Tutoring: An integration strategy to improve and promote peer interactions among students with autism and general education peers. Special section: Behavior analysis in school psychology. *Journal of Applied Behavior Analysis, 27*, 49-61.
- Kamps, D. M., Potucek, J., Lopez, A. G., Kravits, T., and Kemmerer, K. (1997). The use of peer networks across multiple settings to improve social interaction for students with autism. *Journal of Behavioral Education, 7*, 335-358.
- Kauffman, J. M. (2005). *Characteristics of children's behavior disorders* (7th ed.). Columbus, OH: Merrill.
- Kavale, K. A., and Forness, S. R. (1995). Social skill deficits and training: A meta-analysis of the research in learning disabilities. In T. E. Scruggs and M. A. Mastropieri (Eds.), *Advances in learning and behavioral disabilities* (Vol. 9, pp. 119-160). Greenwich, CT: JAI Press.
- Kavale, K. A., and Mostert, M. P. (2004). Social skills interventions for individuals with learning disabilities. *Learnin Disability Quarterly, 27*, 31-43.
- Kavale, K., Mathur, S., Forness, S., Rutherford, R., and Quinn, M. (1997). Effectiveness of social skills training for students with behavior disorders: A meta-analysis. In T. Scruggs and M. Mastropieri (Eds.), *Advances in learning and behavioral disabilities*, vol. 11 (pp. 1–26). New York: Guilford.
- Kavanagh, J. F., and Truss, T. J. (1988). *Learning disabilities: Proceedings of the National Conference*. Parkton, MD: York Press.
- Kern, L., Wacker, D. P., Mace, C., Falk, G. D., Dunlap, G., and Kromrey, J. D. (1995). Improving the peer interactions of students with emotional and behavioral disorders through self-evaluation procedures: A component analysis and group application. *Journal of Applied Behavior Analysis, 28*, 47-59.

- Koegel, L. K., Koegel, R. L., Hurley, C., and Frea, W. D. (1992). Improving social skills and disruptive behavior in children with autism through self-management. *Journal of Applied Behavior Analysis, 25*, 341-353.
- Kohler, E., Schwartz, I., Cross, J., and Fowler, S. (1989). The effects of the two alternating peer intervention roles on independent work skills. *Education and Treatment of Children, 12*, 205-218.
- Kohler, F., Strain, P., Hoyson, M., Davis, L., Donina, W., and Rapp, N. (1995). Using group-oriented contingency to increase social interactions between children with autism and their peers: A preliminary analysis of corollary supportive behaviors. *Behavior Modification, 19*, 10-32.
- Krantz, P. J., and McClannahan, L. E. (1998). Social interaction skills for children with autism: A script-fading procedure for beginning readers. *Journal of Applied Behavior Analysis, 31*, 191-202.
- Ladd, G. W., and Burgess, K. B. (1999). Charting the relationship trajectories of aggressive, withdrawn, and aggressive/withdrawn children during early grade school. *Child Development, 70*, 919-929.
- LaGreca, A. M., and Stone, W. L. (1990). Children with learning disabilities: The role of achievement in the social, personal, and behavioral functioning. In H. L. Swanson and B. K. Keogh (Eds.), *Learning disabilities: Theoretical and research issues* (pp. 333-352). Hillsdale, NJ: Erlbaum.
- Lane, K. L., Givner, C. C., and Pierson, M. R. (2004). Teacher expectations of student behavior: Social skills necessary for success in elementary school classrooms. *Journal of Special Education, 38*, 104-111.
- Lane, K. L., Pierson, M. R., and Givner, C. C. (2003). Teacher expectations of student behavior: Which skills do elementary and secondary teachers deem necessary for success in the classroom? *Education and Treatment of Children, 26*, 413-430.
- Laushey, K. M., and Heflin, L. J. (2000). Enhancing social skills of kindergarten children with autism through the training of multiple peers as tutors. *Journal of Autism and Developmental Disorders, 30*, 183-193.
- Lefebvre, D., and Strain, P. (1989). Effects of a group contingency on the frequency of social interactions among autistic and non-handicapped preschool children: Making LRE efficacious. *Journal of Early Intervention, 13*, 329-341.
- Lewis, T. J., and Sugai, G. (1996). Functional assessment of problem behavior: A pilot investigation of the comparative and interactive effects of teacher and peer social attention on students in general education settings. *School Psychology Quarterly, 11*, 1-19.
- Lochman, J. E., Coie, J. D., Underwood, M. K., and Terry, R. (1993). Effectiveness of a social relations intervention program for aggressive and nonaggressive rejected children. *Journal of Consulting and Clinical Psychology, 61*, 1053-8.
- Locke, W. R., and Fuchs, L. S. (1995). Effects of peer-mediated reading instruction on the on-task behavior and social interactions of children with behavior disorders. *Journal of Emotional and Behavioral Disorders, 3*, 92-99.
- Lovaas, O. I. (1987). Behavioral treatment and normal educational and intellectual functioning in young autistic children. *Journal of Consulting and Clinical Psychology, 55*, 3-9.

- Maheady, L., and Sainato, D. (1986). Learning disabled students' perceptions of social events. In S. J. Ceci (Ed.), *Handbook of cognitive, social, and neuropsychological aspects of learning disabilities* (pp. 381-402). Hillsdale, NJ: Erlbaum.
- Maheady, L., Harper, G. F., and Mallette, B. (1991). Peer-mediated instruction: A review of potential applications for special education. *Reading, Writing, and Learning Disabilities International, 7*, 75-103.
- Malecki, C. K., and Elliot, S. N. (2002). Children's social behaviors as predictors of academic achievement: A longitudinal analysis. *School Psychology Quarterly, 7*, 1-23.
- Mastopieri, M. A., and Scruggs, T. E. (2000). *The inclusive classroom: Strategies for effective instruction*. Upper Saddle River, NJ: Merrill.
- Matson, J. L., and Wilkins, J. (2007). A critical review of assessment targets and methods for social skills excesses and deficits for children with autism spectrum disorders. *Research in Autism Spectrum Disorders, 1*, 28-37.
- Matson, J. L., Nebel-Schwalm, M. S., and Matson, M. L. (2007). A review of the methodological issues in the differential diagnosis of autism spectrum disorders in children: Diagnostic systems and scaling methods. *Research in Autism Spectrum Disorders, 1*, 38-54.
- McFall, R. M. (1982). A review and reformulation of the concept of social skills. *Behavioral Assessment, 4*, 1-33.
- Meier, C. R., DiPerna, J. C., and Oster, M. M. (2006). Importance of social skills in the elementary grades. *Education and Treatment of Children, 29*, 409-419.
- Merrell, K. W. (1993). Assessment of social skills and peer relations. In H. B. Vance (Ed.), *Best practices in assessment for school and clinical settings* (pp. 307-340). Hoboken, NJ: Wiley.
- Morrison, L., Kamps, D., Garcia, J., and Parker, D. (2001). Peer mediation and monitoring strategies to improve initiations and social skills for students with autism. *Journal of Positive Behavior Interventions, 3*, 237-250.
- Nabuzoka, D., and Smith, P. K. (1993). Sociometric status and social behaviour of children with and without learning difficulties. *Journal of Child Psychology and Psychiatry, 34*, 1435-1448.
- Nikopoulos, C. K., and Keenan, M. (2004). Effects of video modeling on social initiations by children with autism. *Journal of Applied Behavior Analysis, 37*, 93-96.
- Northup, J., Broussard, C., Jones, K., George, T., Vollmer, T. R., and Herring, M. (1995). The differential effects of teacher and peer attention on the disruptive classroom behavior of 3 children with diagnosis of attention deficit hyperactivity disorder. *Journal of Applied Behavior Analysis, 28*, 227-228.
- Odom, S. L., and Strain, P. S. (1984). Peer mediated approaches to promoting children's social interaction: A review. *American Journal of Orthopsychiatry, 54*, 544-57.
- Odom, S. L., McConnell, S. R., and McEvoy, M. A. (1992). Peer-related social competence and its significance for young children with disabilities. In S. L. Odom, S. R. McConnell, and M. A. McEvoy, (Eds.), *Social competence of young children with disabilities* (pp. 3-35). Baltimore: Brookes.
- O'Shaughnessy, T., Lane, K. L., Gresham, F. M., and Beebe-Frankenberger, M. E. (2002). Students with or at-risk for learning and emotional behavior disorders: An integrated system of prevention and intervention. In K. L. Lane, F. M. Gresham, and T. E.,

- O'Shaughnessy (Eds.), *Interventions for children with or at risk for emotional and behavioral disorders* (pp.3-17). Boston: Allyn and Bacon.
- Parker, J. G., and Asher, S. R. (1987). Peer relations and later personal development: Are low-accepted children 'at risk'? *Psychological Bulletin*, *102*, 357-389.
- Patterson, G. R. (1993). Orderly change in a stable world: The antisocial trait as a chimera. *Journal of Consulting and Clinical Psychology*, *61*, 911-19.
- Patterson, G. R., Reid, J. B. and Dishion, T. J. (1992) *A social learning approach. Vol. 4: Antisocial boys*. Eugene, OR: Castilla.
- Pearl, R. (2002). Students with learning disabilities and their classroom companions. In B.Y.L. Wong and M. L. Donahue (Eds.), *The social dimensions of learning disabilities: Essays in honor of Tanis Bryan* (pp. 77-92). Mahwah, NJ: Lawrence Erlbaum.
- Pearl, R., Donahue, M., and Bryan, T. (1986). Social relationships of learning-disabled children. In J. K. Torgesen and B. Y. L. Wong (Eds.), *Psychological and educational perspectives on learning disabilities* (pp. 193-224). Orlando, FL: Academic Press.
- Pekarik, E., Prinz, R., Liebert, D., Weintraub, S., and Neale, J. (1976). The pupil evaluation inventory: A sociometric technique for assessing children's social behavior. *Journal of Abnormal Child Psychology*, *4*, 83-97.
- Pierce, K., and Schreibman, L. (1995). Increasing complex social behaviors in children with autism: Effects of peer-implemented pivotal response training. *Journal of Applied Behavior Analysis*, *28*, 285-295.
- Pierce, K., and Schreibman, L. (1997). Using peer trainers to promote social behavior in autism: Are they effective at enhancing multiple social modalities? *Focus on Autism and Other Developmental Disabilities*, *12*, 207-218.
- Putallaz, M., and Helfin, H. (1990). Parent-child interaction. In S. P. Asher and J. D. Coie (Eds.), *Peer rejection in childhood* (pp. 189-216). New York: Cambridge University Press.
- Ragland, E. U., Kerr, M. M., and Strain, P. S. (1978). Effects of peer social initiations on the behavior of withdrawn autistic children. *Behavior Modification*, *2*, 565-578.
- Rhode, G., Morgan, D. P., and Young, K. R. (1983). Generalization and maintenance of treatment gains of behaviorally handicapped students from resource rooms to regular classrooms using self-evaluation procedures. *Journal of Applied Behavior Analysis*, *16*, 171-188.
- Rivera, D. P., and Smith, D. D. (1997). *Teaching students with learning and behaviour problems* (3rd ed.). Boston: Allyn and Bacon.
- Roberts, C., and Zubrick, S. (1992). Factors influencing the social status of children with mild academic disabilities in regular classrooms. *Exceptional Children*, *59*, 192-202.
- Rogers, S. (2000). Interventions that facilitate socialization in children with autism. *Journal of Autism and Developmental Disorders*, *30*, 399-409.
- Royer, E. (1995). Behavior disorders, suspension and social skills: Punishment is not education. *Therapeutic Care and Education*, *4*, 32-6.
- Royer, E., Bitaudeau, I., Desbiens, N., Maltais, N., and Gagnon, M. (1997). Effet d'un programme d'entraînement aux habiletés sociales sur le comportement d'adolescents en difficulté au secondaire. *Science et Comportement*, *26*, 1-16.
- Rubin, K. H., Booth, C., Rose-Krasnor, L., and Mills, S. L. (1995). Social relationships and social skills: A conceptual and empirical analysis. In S. Schulman (Ed.), *Close relationships and socioemotional development* (Vol. 7, pp. 63-94). Norwood, NJ: Ablex.

- Ruffalo, S. L., and Elliott, S. N. (1997). Teachers' and parents' ratings of children's social skills: A closer look at cross-informant agreements through an item analysis protocol. *School Psychology Review, 26*, 489–501.
- Sabornie, E. J. (1987). Bi-directional social status of behaviorally disordered and nonhandicapped elementary school pupils. *Behavioral Disorders, 12*, 45–57.
- Sabornie, E. J., and Kauffman, J. M. (1985). Regular classroom sociometric status of behaviorally disordered students. *Behavioral Disorders, 10*, 268–74.
- Sainato, D. M., Goldstein, H., and Strain, P. S. (1992). Effects of self-evaluation on preschool children's use of social interaction strategies with their classmates with autism. *Journal of Applied Behavior Analysis, 16*, 171-178.
- Scattone, D. (2007). Social skills interventions for children with autism. *Psychology in the Schools, 44*, 717-726.
- Shearer, D., Kohler, F., Buchan, K., and McCullough, K. (1996). Promoting independent interactions between preschoolers with autism and their non-disabled peers: An analysis of self-monitoring. *Early Education and Development, 7*, 205-220.
- Sheridan, S. M., and Walker, D. (1999). Social skills in context: Considerations for assessment, intervention, and generalization. In C. R. Reynolds and T. B. Gutkin (Eds.), *The handbook of school psychology* (3rd ed., pp. 686–708). New York: Wiley.
- Spencer, V. G., Scruggs, T. E., and Mastropieri, M. A. (2003). Content area learning in middle school social studies classrooms and students with emotional or behavioral disorders: A comparison of strategies. *Behavioral Disorders, 28*, 77-93.
- Sridhar, D., and Vaughn, S. (2001). Social functioning of students with learning disabilities. In D. P. Hallahan and B. K. Keogh (Eds.), *Research and global perspectives in learning disabilities: Essays in honor of William M. Cruickshank* (pp. 65-92). Mahwah, NJ: Erlbaum.
- Stephens, M. T. (1992). *Social skills in the classroom*. Odessa, FL: PAR.
- Strain, P. S. (1987). Comprehensive evaluation of intervention for young autistic children. *Topics in Early Childhood Special Education, 7*, 97–110.
- Strain, P. S., and Danko, C. D. (1995). Caregivers' encouragement of positive interaction between preschoolers with autism and their siblings. *Journal of Emotional and Behavioral Disorders, 3*, 2–13.
- Strain, P. S., and Odom, S. L. (1986). Peer social initiations: Effective intervention for social skills development of exceptional children. *Exceptional Children, 52*, 543–551.
- Strain, P. S., Kohler, F. W., Storey, K., and Danko, C. D. (1994). Teaching preschoolers with autism to self-monitor their social interactions: An analysis of results in home and school settings. *Journal of Emotional and Behavioral Disorders, 2*, 78–89.
- Strain, P. S., Shores, R. E., and Timm, M. A. (1977). Effects of peer social initiations on the behavior of withdrawn preschool children. *Journal of Applied Behavior Analysis, 10*, 289–298.
- Strain, P., Kohler, F., and Goldstein, H. (1996). Learning experiences . . . An alternative program: Peer-mediated interventions for young children with autism. In E. D. Hibbs and P. S. Jensen (Eds.), *Psychosocial treatments for child and adolescent disorders: Empirically based strategies for clinical practice* (pp. 573–586). Washington, DC: American Psychological Association.

- Sugai, G., Horner, R. H., Dunlap, G., Hieneman, M., Lewis, T. J., Nelson, C. M., et al. (2000). Applying positive behavior support and functional behavioral assessment in schools. *Journal of Positive Behavior Intervention*, 2, 131-143.
- Taylor, A. R., Asher, S. R., and Williams, G. A. (1987). The social adaptation of mainstreamed mildly retarded children. *Child Development*, 58, 1321-1334.
- Terry, R. (2000). Recent advances in measurement theory and the use of sociometric techniques. In A. H. N. Cillessen and W. M. Bukowski (Eds.), *Recent advances in the measurement of acceptance and rejection in the peer system* (pp.27-53). San Francisco, CA: Jossey-Bass.
- Utley, C. A., Mortweet, S. L., and Greenwood, C. R. (1997). Peer-mediated instruction and interventions. *Focus on Exceptional Children*, 29, 1-23.
- Vaughn, S. (1985). Why teach social skills to learning disabled students? *Journal of Learning Disabilities*, 18, 588-591.
- Vaughn, S., LaGreca, A. M., and Kuttler, A. F. (1999). The why, who, and how of social skills. In W. N. Bender (Ed.), *Professional issues in learning disabilities* (pp. 187-218). Austin, TX: PRO-ED.
- Walker, H. M., and Severson, H. (2002). Developmental prevention of at-risk outcomes for vulnerable and antisocial children and youth. In K. L. Lane, F. M., Gresham, and T. E., O'Shaughnessy (Eds.), *Interventions for children with or at risk for emotional and behavioral disorders* (pp. 38-56). Boston: Allyn and Bacon.
- Warnes, E. D., Sheridan, S. M., Geske, J., and Warnes, W. A. (2005). A contextual approach to the assessment of social skills: Identifying meaningful behaviors for social competence. *Psychology in the Schools*, 42, 173-187.
- Wass, G. A. (1988). Social attributional biases of peer-rejected and aggressive children. *Child Development*, 59, 969-75.
- Wentzel, K. R. (1993). Does being good make the grade? Social behavior and academic competence in middle school. *Journal of Educational Psychology*, 85, 357-364.
- Wiener, J., and Schneider, B. (2002). A multisource exploration of friendship patterns of children with and without LD. *Journal of Abnormal Child Psychology*, 30, 127-141.
- Wolfberg, P. J., and Schuler, A. L. (1993). Integrated play groups: A model for promoting the social and cognitive dimensions of play in children with autism. *Journal of Autism and Developmental Disorders*, 23, 467-489.
- Wolfberg, P. J., and Schuler, A. L. (1999). Fostering peer interaction, imaginative play and spontaneous language in children with autism. *Child Language Teaching and Therapy*, 15, 41-52.
- Wong, B.Y.L. (2003). General and specific issues for researchers' consideration in applying the risk and resilience framework to the social domain of LD. *Learning Disabilities Research and Practice*, 18, 68-76.
- Wood, J. W. (1998). *Adapting instruction to accommodate students in inclusive settings*. Upper Saddle River, NJ: Merrill.
- Wright, D., and Torrey, G. K. (2001). A comparison of two peer-referenced assessment techniques with parent and teacher ratings of social skills and problem behaviors. *Behavioral Disorders*, 26, 173-182.
- Youngstrom, E. A., Loeber, R., and Stouthamer-Loeber, M. (2000). Patterns and correlates of agreement between parent, teacher, and male youth behavior ratings. *Journal of Consulting and Clinical Psychology*, 68, 1-12.

- Youngstrom, E., Izard, C., and Ackerman, B. (1999). Dysphoria-related bias in maternal ratings of children. *Journal of Consulting and Clinical Psychology, 67*, 1-12.
- Zanolli, K., Daggett, J., and Adams, T. (1996). Teaching preschool age autistic children to make spontaneous initiations to peers using priming. *Journal of Autism and Developmental Disorders, 26*, 407-422.

Chapter 12

COMPARING SOCIAL INTERACTIONS OF ENGLISH LANGUAGE LEARNERS AND NATIVE ENGLISH SPEAKERS

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ABSTRACT

This study examined the effects of classwide peer tutoring (CWPT) on social interactions of children who are English language learners and children whose native language is English. Seven English language learners and 7 native English speakers from two second-grade classrooms were selected as the participants. Children's social interactions were operationally defined as 15 social behaviors according to the social interaction observation system (SIOS). These behaviors were further divided into seven positive behaviors, five passive behaviors, and three negative behaviors. Baseline data were collected during the free play time immediately after the 20 minutes of teacher instruction on a specific academic content. In intervention, data were also collected during free-play time, but immediately after the 20-minute CWPT procedure. A single-subject withdrawal design (ABA) was applied, with Phase A the baseline condition and Phase B the intervention (CWPT) condition. All the seven positive behaviors were substantially increased during the CWPT condition and decreased during the baseline condition. A substantial difference was found between the two groups during intervention. The Teacher/Student Satisfaction Questionnaires showed positive responses from participating teachers and students.

BACKGROUND

The number of students whose home language is not English continues to increase every year in the United States. In 2004-2005 school year, approximately 5.1 million U.S. students are English language learners (Payán and Nettles, 2008). Within the public schools, over 2 million English-language learners (ELL) are in pre-kindergarten through grade 3 classrooms

(Abedi, Hofstetter, and Lord, 2004). In addition to language barriers, the challenges for ELL students also involve low-academic achievements that often related to low expectations, inappropriate assessment instruments or procedures that resulted in overrepresentation in higher incidence disabilities, and the lack of effective instructional strategies for teaching ELL students that often lead to behavioral problems, especially for ELL students with learning difficulties or disabilities (Artiles, Rueda, Salazar, and Higareda, 2005; McCardle, Mele-McCarthy, Cutting, Leos, and D'Emilio, 2005).

Along with the deficiencies in content areas such as reading, writing, mathematics, and science, another problem is the lack of positive peer interaction. Many ELL students consider themselves less welcomed or accepted by their peers (Minicucci and Berman, 1995). Erikson's psychosocial theory emphasized the psychological development through the person's interactions within his social environment (Schickedanz, Schickedanz, Forsyth, and Forsyth, 1998). During the early elementary school age years, children's development can be delayed if their potential abilities are not evoked and nurtured (Erikson, 1963).

As children are engaged in more positive interactions through effective communication, become more self-aware, and better at understanding the thoughts and feelings of others, their social skills have improved (Berk, 1999). However, because of the limited language proficiency or different cultural background, ELL students' social interaction may be different from that of their native English-speaking peers. Most studies using CWPT have focused interventions on academic improvements for ELL students (e.g., Greenwood, Arreaga-Mayer, Utley, Gavin, and Terry, 2001; Gersten and Baker, 2000). Very few researchers have examined the social interaction behaviors of these children. Educators need an appropriate instructional method in the general education setting to increase and improve the social behaviors of ELL students.

PURPOSE OF THIS STUDY

The purpose of this study was to examine the effects of Classwide Peer Tutoring (CWPT) on social interaction behaviors of ELL children. CWPT is a specific form of peer-mediated instruction that encourages children in the same age or grade group to learn from each other. As most of the literature demonstrates, CWPT has been effective for increasing academic achievement and improving the classroom behaviors of students with different needs. Children involved in CWPT procedures included typically developing children, students with ADD/ADHD (e.g., DuPaul, Ervin, Hook, and McGoey, 1998), mild mental retardation (e.g., Mortweet, et al., 1999), developmental disabilities (e.g., Utley et al., 2001), and low Socio-economic Status (SES) (e.g., Greenwood, Delquadri, and Hall, 1989). The settings where CWPT has been implemented include special education, general education, and inclusive classrooms. In spite of substantive studies on CWPT that demonstrated increases in academic engagement, academic acquisition, and social skills in diverse student populations, few studies have been done to compare the effects of CWPT on children who are ELL or who are native English speakers (NES) in the general education setting.

The hypothesis for this study was that CWPT would be effective in increasing and improving social interaction behaviors of young ELL and NES students in general education classrooms. Two research questions were addressed:

- 1) Was it effective of CWPT in increasing positive social interaction behaviors of ELL and NES students in general education settings?
- 2) Did CWPT have a *different* effect on the social interaction behaviors of ELL and NES students?

METHODOLOGY

Participants

Participating Children Fourteen children six to eight years of age in two early primary-grade classrooms were selected to participate in the study, seven from each classroom (4 girls, 3 boys). The seven ELL students from Class 1 were all qualified and enrolled in the school district ELL program. The criteria for the ELL program from the local school district were: 1). Primary language is not English; 2). Proficiency in English is below the average proficiency of pupils at the same age or grade level whose primary language is English; and 3). Probability of success in a classroom in which courses of study are taught only in English is impaired because of their limited proficiency in English. The seven NES students from Class 2 were children whose primary language is English and who did not qualify for the ELL program.

Participating Teachers The two classroom teachers from Class 1 and Class 2 participated in this study. Teacher A from Class 1 had two years of teaching experiences in an elementary school, with one year experience teaching first grade and one year teaching second grade. Teacher B from Class 2 also had two years of teaching experiences, with one year teaching fifth grade and one year teaching second grade. Both teachers held a bachelor's degree in elementary education. Teacher A also held a certificate in teaching ELL students. Each teacher signed a consent form to participate in this study.

Settings and Arrangements

The elementary school where this study was conducted was a year round school with a population of 1,178 students. This school was designated as both a high minority and high poverty school. The school had 40 primary teachers (K-3) and 14 intermediate (4-5) teachers. Fifty-five percent of the classroom teachers at this school had taught for less than five years. Both classrooms were observed and videotaped during baseline and intervention phases, but only the selected subjects were included in the analysis.

Measurement

The target behavior was the occurrence of social interactions exhibited by the participants. The social interactions were operationally defined as the 15 social behaviors in the Social Interaction Observation System (SIOS) designed by Kreimeyer, Antia, Coyner, Eldredge, and Gupta (1991). The SIOS was to record the social interactions during free play activities. These behaviors were divided into seven positive behaviors, five passive behaviors, and three negative behaviors (See Table 1).

Table 1. Three Types of Social Behaviors

Positive behaviors

Positive peer interactions

Cooperative play

Positive linguistic interaction

Peer initiations of interaction

Child responds positively to peer initiation

Child initiation of interaction

Peer responds positively to child's initiation

Passive Behaviors

Nonplay behavior

Solitary play

Parallel play

No response to peer initiation

Peer makes no response to child's initiation

Negative behaviors

Negative behaviors directed to peer

Child responds negatively to peer initiation

Peer responds negatively to child's initiation

Adapted from the Social Interaction Observation System (SIOS) designed by Kreimeyer, Antia, Coyner, Eldredge, and Gupta (1991).

The social interaction behaviors of children in both classrooms were videotaped during baseline and intervention phases. Class 1 (ELL students) received a total of five weeks of videotaped observation and one week of training on CWPT procedures. Class 2 (NES students) received three weeks of videotaped observation and one week of training on CWPT procedures.

The videotaped social interaction behaviors of children were coded and recorded by using the SIOS (Kreimyer et al., 1991). Because of the factors such as holidays, track breaks, or student absences, data analyses were based on three sessions each week. Therefore, each participant in Class 1 had 15 videotaped observation sessions for data analyses and Class 2 had 9 sessions for data analyses. The teachers' and students' perceptions on the use of CWPT were measured by using the Teacher/Student Satisfaction Questionnaire.

Baseline data were collected during the free play time immediately after the 20 minutes of teacher instruction on a specific academic content (spelling or math). In intervention, data were also collected during free play time, but immediately after the 20-minute CWPT procedure. The videotapes were analyzed after the completion of the data collection process in order to control for researcher effects. Each participant was rated over four consecutive, one-minute intervals. For each one-minute interval, the social behaviors of the participants were marked as occurred (+) or not occurred (0). This process was repeated for the remaining participants during repeated viewing of the tape.

The process was repeated seven times for all seven participants in each of the two classrooms. The occurrence of each of the 15 behaviors was quantified and analyzed for each participant in the two groups by observer A. Observer B then independently viewed and rated 25% of the sessions to establish interrater reliability on the rating of behaviors.

Materials and Equipment

Materials and equipment needed for this study included Weekly Tutoring List (1 per pair), Tutoring Worksheet, Tutoring Point Sheet, Help Sign (1 per pair), and Timer (1). These materials were age and developmentally appropriate because they were modified from the CWPT manual developed by Greenwood, Delquadri, and Carta (1997) to meet the level of the class according to the teacher's weekly/monthly lesson plans. Learning materials used by each pair were academic items related to the instructional content in the classroom, for example, a list of sight words, a set of counting cards, pictures of animals beginning with the same letter, or upper-lower letter matching cards. The correct answer was indicated on the back of each card or on the tutoring worksheet. This allowed the tutors to provide responses that they could not yet independently make themselves.

EXPERIMENTAL DESIGN

A single subject withdrawal design (ABA) (Barlow and Hersen, 1987) was applied to Class 1 and Class 2, respectively. Phase A was the baseline condition and B was intervention (CWPT) condition. In order to establish a strong functional relationship between the change of behavior and the intervention, Class 1 had been applied five phases: ABABA, with a total of five weeks of data collection. Class 2 had three phases: ABA, with a total of three weeks of data collection.

PROCEDURES

Phase One - Baseline 1

Children's social interaction behaviors from both classes were measured using the SIOS during free play time immediately after the 20-minute teacher instruction. Data were collected from the seven children in Class 1 and seven children in Class 2, for one week in each of the two classrooms, respectively.

Phase Two - Training Sessions

The two teachers from both classrooms were trained with CWPT procedures after the baseline data collection. Each of them received a copy of the CWPT Process prior to the implementation of CWPT in the classroom. The CWPT Process provided an overview of CWPT, including how to schedule the sessions, a breakdown of the time involved, what kinds of content materials to use, and how to pair tutors and assign them to teams. It also included how to give pre-tests and post-tests for each subject area tutored.

After the CWPT procedure was reviewed with the teachers, children from both classrooms were trained to use CWPT for three sessions. Procedures described by Greenwood and others (1997) were used. During the first training session, children were arranged by pairs. Each pair of students sat next to each other and started working as a tutor and a tutee. First the teacher described and modeled peer tutoring procedures to the whole class. The class then practiced tutoring for about 15 minutes. Each child had an opportunity to be a tutor and tutee. During the second training session, children in each classroom were assigned randomly as tutor and tutee working on a list of 15 spelling words. Each child was also assigned by the teacher to one of the two teams in the whole class level. This session lasted about 20 minutes. During the third session, children were reassigned by the teacher with different partners from the previous session. They worked on math (addition with base-ten blocks) instead of spelling words using CWPT procedure. This session also lasted for 20 minutes. Children who were absent the previous day were trained in both spelling and math areas.

Phase Three - Intervention 1

Beginning in the third week, intervention (CWPT) procedure was applied to each of the two classrooms. There were seven pairs in each classroom. On the days when the number of attendance was odd due to students' absence, three students worked together instead of a pair as practiced in training sessions. The teacher used the CWPT strategy to instruct and practice spelling or math.

The tutor and the tutee were seated at separate, adjacent desks and the tutor was provided with a script of academic material (e.g., 10 math problems or a list of 12-15 spelling words) related to the instructional content. Items were dictated one at a time from the script, with the tutee responding orally to the presented item. Two points were awarded by the tutor for each correct response the first time. If the tutee was wrong the first time, the tutor would provide

the correct answer and the tutee would attempt to replicate the correct response three times to earn 1 point. No points were awarded if the student was unable to answer correctly three times. The item list would be presented as many times as possible for 10 minutes. Then these two students switched roles, with the original tutor now receiving instruction from the former tutee for an additional 10 minutes. Data were collected immediately after CWPT was completed.

Phase Four -Baseline 2

After a one-week intervention phase, CWPT was withdrawn and both classes were back to baseline condition. Data were collected immediately after the teacher instruction.

Phase Five - Intervention 2 (Class 1)

After another week of baseline the CWPT program was reintroduced to Class 1. Data on social behaviors were collected immediately after CWPT was completed.

Phase Six - Baseline 3(Class 1)

During the last week, CWPT was once again withdrawn and Class 1 returned to the baseline condition. Data on social behaviors were collected immediately after the teacher instruction. Class 2 did not participate in Intervention 2 and Baseline 3 due to track break.

SOCIAL VALIDITY

At the end of the study each teacher completed the Teacher Satisfaction Questionnaire (a 10-item survey) developed by DuPaul and colleagues (1998) addressing the social and academic benefits of CWPT. Each item was answered on a 3-point Likert-type scale ranging from not true to very true. The teachers were also asked to evaluate the logistical aspects of CWPT (.e.g., time consuming, or ease of implementation).

To assess the students' satisfaction, the Student Satisfaction Questionnaire (a 5-item survey) adapted from DuPaul and colleagues (1998) was administered at the end of the study in each class. These five true-false items assessed the degree to which the students enjoyed peer tutoring and believed that it was helpful in peer interactions. The students were also asked about their desire to participate in CWPT in the future.

In Class 1, the teacher read each item in both English and Spanish to make sure every child understood the meaning of each question. In Class 2 the teacher read each item only in English. Any questions were explained and clarified before children completed the survey. All children in each class were asked to complete the survey although only the answers from the selected participants were used for the data analysis.

RESULTS

Interrater Reliability

Interrater reliability was calculated by comparing the ratings of Observer A to Observer B on 25% of the videotaped CWPT and non-CWPT sessions. Interrater reliability on the SIOS was determined by $[\text{agreements} / (\text{agreements} + \text{disagreements})] \times 100 = \text{percent of agreement}$.

First, Observer A viewed all the videotapes and rated the social interaction behaviors of children from the two groups using the SIOS. Then, Observer B viewed 25% (6 out of 24 tapes) of the videotapes and rated children's social behavior using SIOS. Interrater agreement was 99.4% on the SIOS.

SIOS Data

Figure 1 displays the data for each individual ELL participant from Class 1. Figure 2 presents data for each individual NES participant from Class 2. Both groups of figures show that children from the two groups were engaged more during CWPT condition than they were during baseline condition.

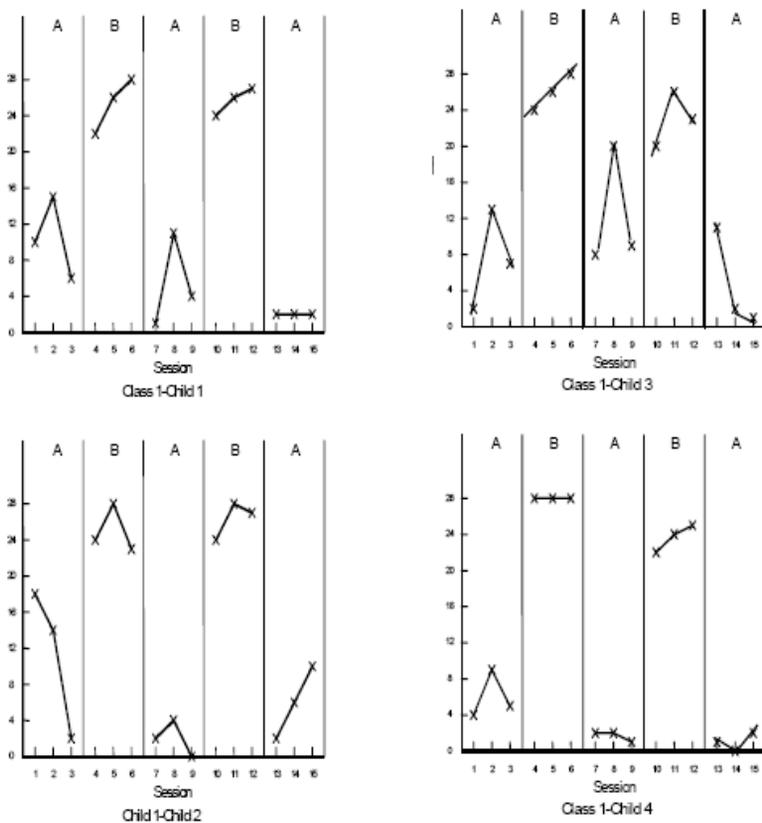


Figure 1. (Continued on next page.)

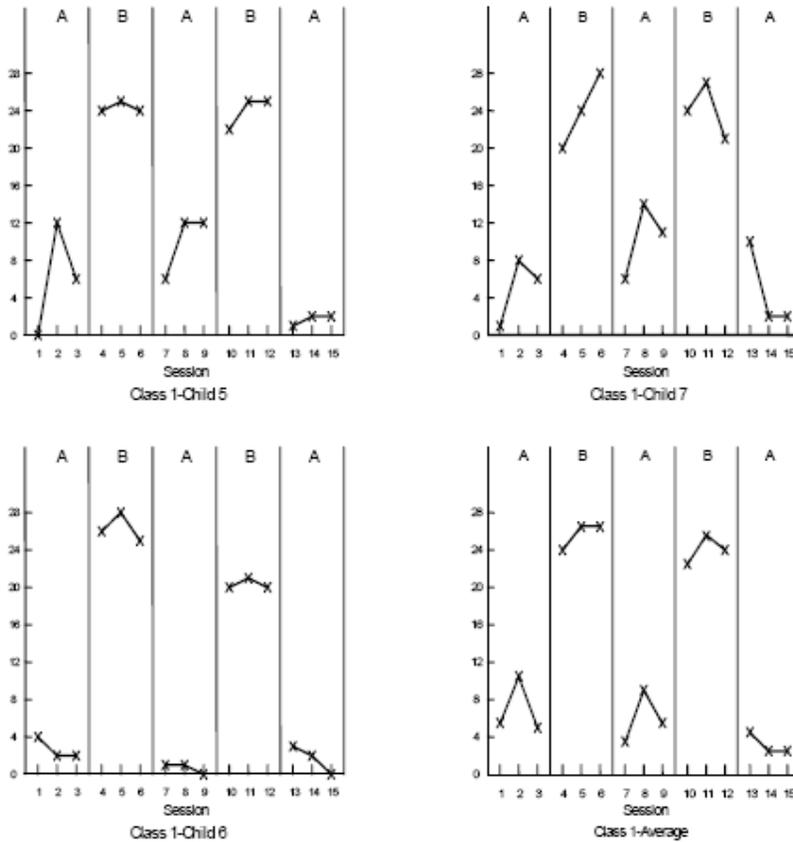


Figure 1. Occurrence of Seven Positive Behaviors of Class 1.

Figure 3 presents the occurrence comparison between the two groups on seven positive behaviors in baseline and intervention phases. These data show a substantial difference between the two groups during intervention. That is, the intervention (CWPT) was more effective for ELL students than that for NES students.

Teacher/Student Satisfaction Questionnaire

At the end of this study, the two classroom teachers and all the participating students from both classes were asked to complete the Teacher/Student Satisfaction Questionnaire. Both Teacher A and Teacher B answered with very true for the social and academic benefits of using CWPT in their classrooms. Teacher A answered the item 5 (time consuming) with somewhat true. She made an additional comment stating that time consuming was somewhat true in the beginning, but it was not a time consuming issue after the first week of implementing the intervention. Teacher B answered the last item (token economy and time-out) with somewhat true. He also commented that sometimes classroom management was necessary to organize activities. All the 28 students from both classrooms answered with yes to all the five items from the Student Satisfaction Questionnaire, although data were only collected and analyzed on the 14 participants from both classrooms.

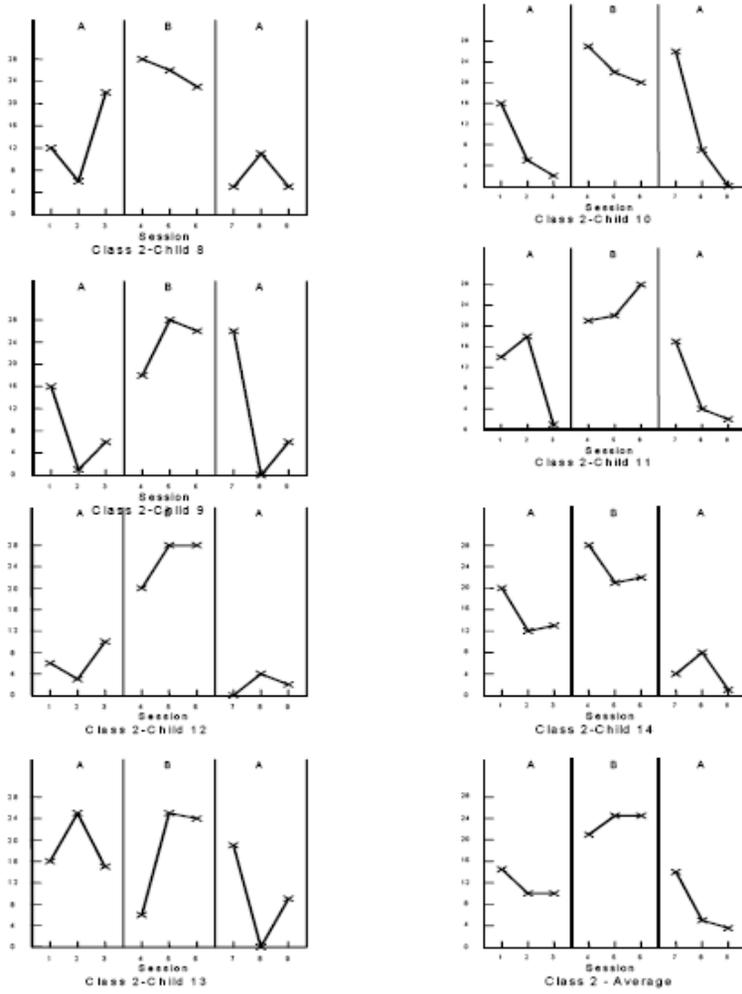


Figure 2. Occurrence of Seven Positive Behaviors of Class 2.

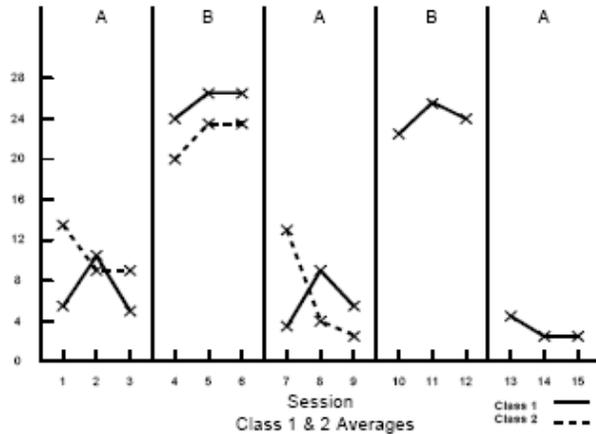


Figure 3. Class 1 and Class 2 Mean Comparison of Positive Behaviors .

DISCUSSION

The main purpose of this study was to compare the effects of Classwide Peer Tutoring (CWPT) on the social interaction behaviors of ELL students and NES students. The overall effectiveness of the treatment indicates that regardless of the culturally and linguistically different backgrounds of the participating children, every child in the study showed a significant increase in all the seven positive social interaction behaviors. The effectiveness of the intervention was especially obvious on specific children (1, 4, 5, 6, 7, 9, 10, and 13) (See Figures 1 and 2).

A substantial difference was detected by visually reviewing the single subject graphs and comparing the occurrence between the two groups on the 7 positive behaviors. Overall, there was a more obvious effect of the intervention on the participants in Class 1. For example, five of the seven children in Class 1 had exhibited no overlapping display between baseline and intervention (child 1, child 4, child 5, child 6, and child 7).

In Class 2, four out of seven children had an overlap between baseline and intervention (child 8, child 9, child 10, and child 13). This indicates that the difference between baseline and intervention for NES students was not as significant as for ELL students. Specifically, in Class 1, the social interaction was lower than that in Class 2 during baseline, but higher than Class 2 during intervention (See Figure 3). This may also suggest that some NES students might not need CWPT for social benefits because their social interactions were at acceptable levels.

Comparing frequency of positive social interaction behaviors between the two groups also indicates a more obvious effect of the intervention on ELL students. For Class 1, the total occurrence of all the seven positive behaviors during first baseline was 136. During intervention the occurrence was increased to 537, with an increase of 295%. Then during the second baseline it dropped to 127, decreased 323% from the intervention. For Class 2, during first baseline the occurrence of positive behaviors was 225, then during intervention it increased to 491. The increase was 118% compared to the 295% in Class 1. From intervention to baseline the occurrence was again dropped to 156, decreased 215% from intervention.

The frequency comparison indicates at least two points. One, there was more increase of social interaction behaviors during the intervention for Class 1 than for Class 2. Two, after the intervention was withdrawn, both groups' positive social interaction behaviors dropped even lower in the second baseline than that in the first baseline.

The more effectiveness of the intervention for ELL students might suggest that ELL students are more willing to interact with their peers when the environment is appropriately prepared for them. According to Montessori's theory, children learn best in a well-prepared, child-centered environment in which they can do things for themselves (Morrison, 1998). Children are always curious about new information and knowledge. The diverse cultural and linguistic backgrounds among ELL students can stimulate children's motivation to interact each other when they are encouraged to do so.

The fact that both groups' occurrence of positive social interaction behaviors was dropped lower in the second baseline than when they were started might indicate the influence of research effect. Because children indicated that they enjoyed the CWPT procedure during intervention, they might be expecting the same procedure would happen

after they were back to baseline. When their expectation was not met (for the research purpose of this study), the disappointment might affect how they behaved. The extra two phases (BA) for Class 1 further supported this trend. When Class 1 was back to intervention in the fourth week, their positive social interaction occurrence was increased again from 127 to 501, with 294% increase. Then, the occurrence was down again from second intervention to third baseline. This time it was decreased 671% from 501 in second intervention to 65 in third baseline.

One of the strengths of single subject design is to detect the individual difference between participants and within participants that group comparison often cannot identify if the number of participants were too small. The single subject design also identifies the individual difference for each participant between baseline and intervention that cannot be measured by simply comparing the means. For example, Child 6 was observed to exhibit very low level of social interaction in the beginning (almost zero), but his social interaction behaviors were significantly increased during the intervention. This may provide information for the teacher to prepare more peer-mediated instruction for that specific child. Unlike Child 6, Child 13 showed fairly high social interaction during baseline and maintained at high level in intervention. This information suggests that intervention may not be necessary for this particular child.

In addition, the personality difference of individual children may also have an effect on their social interaction behavior. However, the data from this study show that all children's social interaction behaviors were increased during intervention. This finding indicates that a child may choose to be alone due to the environmental arrangement rather than the lack of social skills of interacting. When the environment is appropriate for social interaction (such as the CWPT condition), the child would be willing and be able to interact with others. Besides the comparison between the ABA phases from the two groups, the two additional phases from Class 1 added more confidence to the significant level by showing the increase in a second B and decrease in another A.

IMPLICATIONS AND LIMITATIONS

For future studies, more data are needed for ELL students from diverse cultural and linguistic backgrounds because the current research primarily focused on Spanish speaking children. Moreover, a longer period of study is needed to investigate the long term effects of CWPT on social interaction behaviors. Additionally, this study observed the social interaction of children immediately after CWPT was implemented. A more conservative design should be developed in terms of the effects of CWPT because the spillover effects of peer tutoring could carry over at least 24 hours. Therefore, one option would be for the observation to be conducted the next day after CWPT is used in order to examine its lasting effects.

In the current study, the single subject design ended with the baseline condition (ABA) other than intervention condition (ABAB). Other forms of single subject design can be applied in the future. For example, a withdrawn design with ABAB can be used to avoid ending in baseline condition. Or a multiple baseline design can be used across subjects and settings. Or these two designs can be combined together to establish a stronger functional relationship between the intervention and target behavior.

REFERENCES

- Abedi, J., Hofstetter, C.H., and Lord, C. (2004). Assessment accommodations for English-language learners: Implications for policy-based empirical research. *Review of Educational Research*, 74(1), 1 – 28.
- Artiles, A., Rueda, R., Salazar, J. J., and Higareda, I. (2005). Within-group diversity in minority disproportionate representation: English language learners in urban school district. *Exceptional Children*, 71, 283-300.
- Barlow, D. H., and Hersen, M. (1987). *Single case experimental designs*. Needham Heights: MA: Allyn and Bacon.
- Berk, L. E. (1999). *Infants and children*. Needham Heights, MA: Allyn and Bacon.
- DuPaul, G. J., Ervin, R. A., Hook, C. L., and McGoey, K. E. (1998). Peer tutoring for children with attention deficit hyperactivity disorder: Effects on classroom behavior and academic performance. *Journal of Applied Behavior Analysis*, 31, 579-592.
- Erikson, E. (1963). *Childhood and society* (2nd ed.). New York: W. W. Norton.
- Gersten, R., and Baker, S. (2000). What we know about effective instructional practices for English-language learners. *Exceptional Children*, 66, 454-470.
- Greenwood, C. R., Arreaga-Mayer, C., Utley, C. A., Gavin, K. M., and Terry, B. J. (2001). Classwide peer tutoring learning management system. *Remedial and Special Education*, 22(1), 34-47.
- Greenwood, C. R., Delquadri, J., and Carta, J. J. (1997). *Together we can: Classwide Peer Tutoring for basic academic skills*. Longmont, CO: Sopris West.
- Greenwood, C. R., Delquadri, J. C., and Hall, R. V. (1989). Longitudinal effects of classwide peer tutoring. *Journal of Educational Psychology*, 81, 371-383.
- Kreimeyer, K., Antia, S., Coyner, L., Eldredge, N., and Gupta, A. (1991). *Social interaction observation system: Project interact*. Tuscon, AZ: University of Arizona.
- McCardle, P., Mele-McCarthy, J., Cutting, L., Leos, K., and D'Emilio, T. (2005). Learning disabilities in English language learners. Identifying the issues. *Learning Disabilities Research and Practice*, 20, 1-5.
- Minicucci, C., and Berman, P. (1995). School reform and student diversity. *Phi Delta Kappan*, 77(1), 77-81.
- Mortweet, S. L., Utley, C. A., Walker, D., Dawson, H. L., Delquadri, J. C., Reddy, S. S., et al. (1999). Classwide peer tutoring: Teaching students with mild mental retardation in inclusive classrooms. *Exceptional Children*, 65, 524-536.
- Morrison, G. S. (1998). *Early childhood education today*. Upper Saddle River, NJ: Prentice-Hall, Inc.
- Payán, R., and Nettles, M (2008). *Current state of English-language learners in the U.S. K-12 student population*. Retrieved on July 25, 2008. Available at: http://www.ets.org/Media/Conferences_and_Events/pdf/ELLSymposium/ELL_fac_tsheet.pdf
- Schickedanz, J., Schickedanz, D., Forsyth, P., and Forsyth, G. (1998). *Understanding children and adolescents* (3rd ed.). Needham Heights, MA: Allyn and Bacon.
- Utley, C. A., Reddy, S. S., Delquadri, J. C., Greenwood, C. R., Mortweet, S. L., and Bowman, V. (2001). Classwide peer tutoring: An effective teaching procedure for

facilitating the acquisition of health education and safety facts with students with developmental disabilities. *Education and Treatment of Children*, 24(1), 1-27.

Chapter 13

AN ASSESSMENT OF AN INSTRUMENT WITH WHICH TO CONDUCT INTERNAL AUDITS

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ABSTRACT

As a result of the financial demise of several international corporations in recent years, the need for competent internal audits has received significant attention. Although most corporations conduct internal audits, their effectiveness has often been suspect and many of the existing instruments with which to measure internal audit effectiveness have severe limitations. Development of the new instrument to quantitatively measure the effectiveness of internal audit functions is clearly needed. This study uses the Internal Audit Professional Practice Framework to examine the validity and reliability of a new instrument with which to conduct internal audits. The results suggest that the instrument is highly reliable and conforms to the standards established by the Institute of Internal Auditors -- the professional organization governing the internal auditing profession.

Keywords: *Enterprise Risk Management (ERM), Internal auditing, COSO ERM Framework.*

AN OVERVIEW OF CONTEMPORARY PRACTICE OF INTERNAL AUDIT

The worldwide business environment has experienced rapid and revolutionary change with extensive consequences for organizations. Managements' response to global competition include improved quality and risk management initiatives, reengineered structures and

processes, and greater accountability. The emphasis is more on timely, reliable, and relevant information for decision-making. Organizations are moving quickly to establish effective governance structures and financial disclosures and processes. In such a climate, the internal audit function is viewed as the most qualified group of professionals to help improved governance. To take advantage of this tremendous surge in the demand for their services, internal auditors need an enhanced repertoire of skills, attributes, and competencies. They also need to significantly raise their organizational status and profile and align themselves appropriately within their respective organizations.

In June 1999 the Institute of Internal Auditors (IIA) provided a new definition of internal auditing which was designed to accommodate the profession's expanding role and responsibilities:

“Internal auditing is an independent, objective assurance and consulting activity designed to add value and improve an organization's operations. It helps an organization accomplish its objectives by bringing a systematic, disciplined approach to evaluate and improve the effectiveness of risk management, control, and governance processes.”

As multinational enterprises have recognized an increasing array of risks facing the organization, it is no surprise that the demand for risk management professionals has risen dramatically (Roth, 2006). The significance of Internal Auditors in ERM was demonstrated by IIA in the new definition of Internal Auditing above. Risk can be considered both at the macro or portfolio level (enterprise-wide risk management) as well as the micro or departmental level. Risk management is frequently an area in which internal audit can contribute greatly by furnishing analyses and providing wise counsel to top management and the board of directors. The internal audit function also performs micro level risk assessment to identify those areas which demand the greatest efforts on the part of the internal audit function and for achieving appropriate audit coverage of the audit universe over defined periods of time.

AN OVERVIEW OF ERM

Internal auditors can play a significant partnering role with management in establishing and monitoring business processes for the assessment, measurement, and reporting of risks in general and in implementing enterprise risk management initiatives. Modern approaches to risk-based internal auditing allow for the assessment of risks and linking them to business objectives systematically (Walker, Shenkir, and Barton, 2002; DeLoach, 2000). Indeed, the internal audit function can facilitate the processes by which business units may develop high quality risk assessments. This can in turn be very useful to the internal audit function in planning its own work, primarily by enhancing the quality of decision-relevant information and minimizing duplication of effort.

ERM is the concept of providing a principle based approach to risk management on a company wide basis. The basic tenets of ERM are to provide corporate governance and professional practice to risks arising from operations, financial practice, and strategic planning (Connolly, 2004). Price-Waterhouse-Coopers LLP first developed the new ERM framework which was adopted by The Committee of Sponsoring Organizations (COSO) of

the Treadway Commission. COSO was formed to formulate and articulate the premises of enterprise risk management and to provide guidance to organizations wishing to implement an integrated and comprehensive approach to protecting the enterprise's assets and operations.

Businesses have become increasingly complex and hard to control. It is also recognized by many business practitioners that the modern enterprise is subject to business risks, which involve failures of people or business processes (Evans, 2004). ERM is a top-down integrated and comprehensive process for determining, evaluating, assessing, controlling, and otherwise monitoring all manner of risks faced by corporations (Baird, 2005). By fully integrating the concepts of ERM with internal control systems, the enterprise can better cope with the pressures of a demanding, investing public.

Management has a renewed interest in risk management and a new profound interest in internal auditing (Beasley and Clune, 2005). The current atmosphere suggests that this heightened interest will remain strong for some time in the future. To be sure, ERM is still a work in progress and has not gained universal acceptance (Beasley and Clune, 2005). The scandals of the first half of this decade have created more urgency in the area of corporate governance and internal audit controls. Clearly the volatility of the various financial markets, not to mention the new complexities that the global economic reality have brought into existence, point to the need for a systematic approach to improved corporate governance and oversight. Thus, ERM may be the best answer to these obvious concerns.

The Institute of Internal Auditors recognized the changing roles of internal auditors with the release of the revised International Standards for the Professional Practice of Internal Auditing Standards. The institute highlighted internal auditors as an indispensable cornerstone of effective organizational governance. They claimed that internal auditors are a critical component to effective and efficient operation and an invaluable contributor to an organization's system of internal control, risk management and governance. The institute viewed this new role so significantly they composed a Position Paper on Enterprise-wide Risk Management in September 2004 and another position paper on Organizational governance: Guidance for Internal Auditors in July 2006. The paper highlights various roles expected of internal auditors in the implementation of ERM and ensuring effective organizational governance (Position Paper, 2006 and 2004).

RESEARCH OBJECTIVES

The present study attempts to achieve the primary objective of developing a valid and reliable instrument that quantitatively measures ERM implementation and roles of internal auditors in such implementation. The second objective is to assess the extent to which the new instrument conforms to the existing frameworks. The next part of the paper discusses the existing literature which focuses on the instruments used to measure ERM and the development process.

Justification for New ERM Instrument

Review of related literature concerning instruments on ERM revealed various approaches attempted to measure the ERM. A list of the existing instruments measuring ERM is presented in Table 1. Some of the instruments provide detailed measures covering broad spectrum of ERM range from the existence of Chief Risk Officer while others used identify and evaluate risks. However, most of the existing measures are not based on COSO's framework of ERM. The set of questions designed also varied widely dependent on the author's interest thus, consistent with what was reported by Kimbrough (2006).

Major weaknesses of the existing instruments measuring ERM are subjective in nature. All of instruments surveyed used categorical, binary as well as Likert-based scale. Examples of the measurement or scales used in existing ERM instruments are also presented in Table 1. The nature of measurement obviously further limits the ability to quantify the degree of ERM implementation. The existing instruments that used categorical measures suffer major weaknesses particularly on the ability to perform various useful statistical tests. This is mainly due to the nature of data collected which categorized as ordinal in nature (Keller, 2000). Ordinal data are best analyzed using non-parametric statistical tests. In fact, the analyses of the existing instruments were mainly on the frequency and the percentage for each category or mainly the descriptive statistics.

Table 1. List of Existing Instruments Measuring ERM

No.	Author	Scales	Component Assessed	Contribution	Limitations
1	AON, (2007)	-rank of 5-point Likert based	- risk description -damage to reputation -business interruption -third party liability -distribution and supply chain failure -market environment -risk preparedness	-focus more on risk concern by management -cover extent of preparedness towards risks	-questions asked were too simple -cover small aspect of ERM -subjective measures -not based on COSO
2	CAS, (2001)	- categorical	-type of risks -level of knowledge in ERM -sources of ERM knowledge -average time spent in ERM -analysis and quantification of risk -assessment on risk prioritization -Type of practitioners in ERM unit -primary roles in ERM	-very detailed attributes -mainly focus on actuarial society	-MCQ measures- limit analysis -Not based on COSO
3	Copeman and Joy, (2006)	- categorical	-major ERM driving force -approach in ERM -existence of ERM framework -existence of CRO position -effectiveness of ERM	-focus more on existence of CRO	-cover limited aspect of ERM -not based on COSO -subjective measures
4	Deloitte,	-	-risk governance	-various	-not based on

No.	Author (2004)	Scales categorical	Component Assessed	Contribution practical aspect of ERM	Limitations COSO
			-regulatory and economic capital -ERM process -credit risk management -Market risk and assets management -operational risk management -risk system and technology	-based on Basel II frameworks (financial institutions)	-only applicable to financial institutions -subjective measures
5	IACCM, (2002)	-index -score of 4-point 1, novice 2, competence 3, proficient 4, expert	-assess maturity of ERM -Basis of assessment -culture -process -experience -application -Each were assessed using 4point categorical measures	-based on organizational maturity model -more objective measures	-not based on COSO -categorical based thus limit to ordinal data
6	IIA, (2005)	- categorical	-impact of COSO framework on company ERM plan -status of ERM activities -benefits of ERM as based on COSO framework -primary ERM implementation barriers. -role of internal auditors in ERM process -Importance of IT on risk management process	-based on COSO -incorporate role of internal auditors -measure impact of IT on risk management	-subjective measures - categorical, limit respondent's choice
7	Kimbrough, (2006)	-Likert-based with quantitative measures	-internal environment -objective setting -event identification -risk assessment -risk response -control activities -information and communication -monitoring	-cover the whole COSO framework -quantitative scales	-no detailed items for each attributes - to certain extent data are ordinal.
8	KPMG, (2005)	- categorical	-risk policy and strategy -risk structure -risk optimization -risk portfolio -measuring and monitoring risk	-more serious issue on ERM -partly on COSO framework	-not entirely based on COSO -subjective measures -no detailed attribute provided.

Table 1. (Continued)

No.	Author	Scales	Component Assessed	Contribution	Limitations
9	Protiviti, (2005)	-Likert- based, 10- points	-changes in risk profile -risk management capabilities -quantifying and deploying risk -ownership of risk capabilities -current status of risks	-detailed item for each attributes -analyze present state of ERM	-subjective -Not based on COSO
10	PWC, (2004)	- categorical -Likert- based	-ERM function and process -motivation to adopt ERM -company sentiment towards ERM -risk assessment -risk management responsibility -risk source -risk categorization -risk communication -benefits of ERM	-broad scope	-no specific scope or ERM -not based on COSO's -subjective measure
11	PWC, (2006)	- categorical Likert- based	-ERM function and process -motivation to adopt ERM -company impression on ERM -risk assessment -risk management responsibilities -risk source -risk categorization -risk communication -benefits of ERM -COSO framework on ERM	-use COSO framework	-subjective measures
12	RMA, (2006)	- categorical -Likert- based	-placement of ERM management -influences driving ERM -benefits of ERM -effectiveness of ERM -function included in ERM -existence of separate unit of ERM -responsibility of ERM units -existence of formal ERM policy -frequency of meeting -existence of risk language -challenges in implementing ERM	-various aspect of ERM -consider formal ERM policy -separate unit of ERM	-not based on COSO -subjective measures – Likert-based
13	Wechsler , (2007)	- categorical	-risk identification -risk analysis and quantification -risk response and mitigation -risk reporting and monitoring -the use of technology in ERM -risk terminology used	-consider various aspect of ERM -include the impact of technology on ERM	-subjective measures -limit results to percentage -not entirely based on COSO

No.	Author	Scales	Component Assessed	Contribution	Limitations
			-person primarily responsible for ERM -key challenge to implement ERM	-base on COSO	

The existing instruments were not based on COSO framework on ERM, which resulted in a different spectrum of ERM being focused. The framework which was released in September 2004 (COSO, 2004) starts gaining attention of various institutions concerning the ERM (IIA, 2004).

Despite the drawback of existing ERM instruments, Kimbrough (2006) designed a new improved instrument measuring the implementation of ERM. Kimbrough had modified the Likert-based measurement scale into a 5-point measurement scale by assigning percentages using exact proportion between each point. Example of the scale is 0%, 25%, 50%, 75% and 100%. Kimbrough (2006) claimed that such a scale would be able to provide quantitative measure on ERM implementation. In addition, the ERM instrument by Kimbrough was designed entirely based on COSO framework on ERM. Although there was an improvement to the existing measure of ERM aimed to provide quantitative measures, Kimbrough failed to provide details of sub-categories for each of the eight components in the COSO's ERM framework. The broad definition of each category limited the respondents' ability to provide reasonable answers. This may limit the ability to obtain a correct picture of the stage of ERM implementation.

Considering the limitations of the existing instrument on ERM as well as the need to quantitatively measure ERM implementation, there is a need to develop a new ERM instrument. The new instrument is expected to be able to provide improvement to the existing ERM measures. Each part of the COSO's ERM framework needs to be further expanded with more questions. Optimistically, these questions are able to help respondents to provide correct picture on the implementation of ERM in their respective organization. The next part dealt in detail with the development of the new ERM instrument aimed to provide quantitative measures of ERM implementation.

BASIS OF DEVELOPMENT

There are various sources utilized for the development of the COSO's Enterprise Risk Management-Integrated Framework instrument. The IIA's Position Paper on the role of internal audit in Enterprise Risk Management, use previous research papers and focus group interviews. These sources provide valuable input the instruments' ability to measure the implementation of ERM as well as the significance of internal audit process. The main structure of the instrument was developed based on the various attributes of ERM framework issued by COSO(2004) .

The second part of the instrument measures the effect of internal auditors' involvement in the implementation of ERM. The designed was based on the IIA's Position Paper issued by IIA (IIA, 2004). The Position Paper further indentifies core roles, legitimate roles and roles internal auditors should not undertake, as the three main classifications for roles of internal auditors in the implementation of ERM. The core internal auditors' roles in ERM were inline

with the internal auditor assurance activities while the legitimate roles reflect the internal auditor’s consulting roles. These new assurances and consulting activities were the reflection of the new definition of internal audit (IIA, 2006a). Measurement to be utilized in the instrument is based on the consideration of the existing instruments on ERM including those of Kimbrough (2006).

THE STRUCTURE OF ERM INSTRUMENT

The ERM instrument in the present study aims to provide valid and reliable quantitative measures of ERM implementation and measures the degree of internal auditors’ involvement in the ERM. The instrument was termed as the Significance of Internal Auditors in the Implementation of Enterprise Risk Management (ERM). The four (I am counting five) main parts consist of the (1)cover letter, (2)respondent’ details, (3)ERM implementation, (4)role of internal auditors in ERM and (5)comments on ERM implementation. The next paragraph provides details of each part. The instrument’s structure is presented in Figure 1.

The cover letter provides an overview and purpose of the study. A brief introduction about the topic was presented as to bring respondent’s focus to the topic. The last paragraph of the letter requests the respondent to respond to the questions frankly and honestly. In addition, the respondents were also assured on the confidentiality of the data provided.

The second part of the instrument is termed as Section 1 aimed to collect the respondent’s demographic data. Clear instructions including an example on how the respondent should complete the instrument are stated in this section. Three demographic data asked include: employment category, primary functional title and gender. Four questions request respondent to indicate the ERM status in their organization. Examples of the questions are, “If your organization is implementing ERM, how long has this been underway?”, “Does your organization have separate ERM units?”, “Does your organization have a risk officer?” and finally “Who is primarily responsible for the ERM program in your organization?”

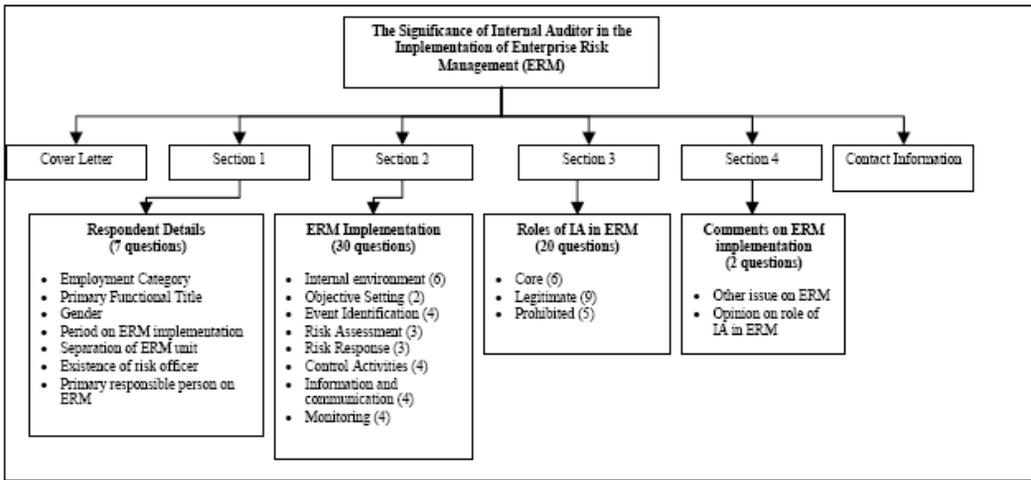


Figure 1. Structure of the new ERM Instrument.

The third part of the instrument is the main element which covered ERM implementation appeared in Section 2. There are initially 45 questions in this section. After the review process, 14 questions were excluded from this section. These questions will be addressed in another section on instrument validity. All of the questions were designed based on the COSO’s ERM framework. There are eight elements in the framework which consist of (1) internal environment, (2) objective setting, (3) event identification, (4) risk assessment, (5) risk response, (6) control activities, (7) information and communication and (8) monitoring.

The next paragraph provides a brief explanation of each element. There are 30 questions to measure the degree of ERM implementation as presented in Table 2. These questions covered COSO’s entire framework on ERM which is presented in Figure 2.



Figure 2. COSO’s ERM Framework.

Table 2. Questions Measuring ERM Implementation

Attribute	Question No.	The Question
Internal Environment	1	considered and understood the risk appetites of the key groups of stakeholders.
	2	established procedures to suit all key stakeholders’ risk appetites.
	3	upholds integrity and ethical values in every part of organization.
	4	set responsibilities in relation to ERM for all board members and senior executives.
	5	set up the risk committee in addition to the existing audit committee.
	6	established a specific post of Chief Risk Officer to be responsible for all ERM issues.
Objective Setting	7	set clear long-term objectives and strategies for the whole organization.
	8	set clear long-term objectives and strategies for every unit in the organization.

Table 2. (Continued)

Event Identification	9	evaluated all elements affecting the achievement of the organization's objectives and strategies.
	10	critically evaluated the consequences of each individual risk.
	11	critically evaluated the association between one type of risk to another type of risk.
	12	established proper methods or techniques to identify risks.
Risk Assessment	13	evaluated the frequency of risk event.
	14	evaluated the cost impact of risks.
	15	utilized the following risk evaluation techniques:
		point estimates
		probabilities / frequency
		lost range
		best/ worst case scenarios
	16	established policy to ensure risk response is effectively carried out.
	17	implemented the above risk response policy.
	18	responds to risks by :
		accepting risks
		avoiding risks
		sharing risks
		reducing risks
Control Activities	19	determined the control activities required to reduce risks.
	20	evaluated all costs related to the control activities.
	21	measured the extent of control activities which reduced the probability of risk estimate.
	22	assessed the total risk cost, i.e. cost of risk impact and cost of control activities.
Information and Communication	23	measured actual occurrences of all risks.
	24	measured actual cost incurred for risk response.
	25	established periodic reporting of ERM.
	26	the effectiveness and overall cost of ERM processes is reported to the board of directors by the Chief Risk Officer or other responsible executive.

Monitoring	27	performed separate risk evaluations by comparing actual event occurrences with estimates.
	28	evaluating the actual cost impact of risk sharing or reduction with the estimate.
	29	reassessed risk identification by considering any changes on the organization's risk appetite, objectives and strategies.
	30	revised estimates for:
		Risk probabilities/ frequency
		Shared/ reduce risks
		Cost impact

The first element is internal environment which encompasses the tone of an organization. It is crucial for top management to set the standard on how risks are viewed and addressed in the organization. Among the main concerns pertaining to internal environment are the organization's risk management philosophy and risk appetite. The ethical values, integrity and overall environment promote the implementation of these elements. There were six questions concerning the organization's internal environment. Example of the questions are, "Your organization considers and understands the risk appetites of the key group of stakeholders", "establishes procedures to suit all key stakeholders' risk appetites" and "upholds integrity and ethical values in every part of the organization".

The second element is objective setting. The framework highlighted that the organization must establish their objectives before the management team can identify potential events affecting the achievement of objectives. The ERM assures that the management team has in place appropriate processes to set objectives. Two questions measured this aspect of ERM implementation. Examples of the questions include "your organization set clear long-term objectives and strategies for the whole organization" and "your organization set clear long-term objectives and strategies for every unit in the organization".

The third element in the framework is event identification. It is known to us that both internal and external factors may affect the organization's performance. This element specifically focuses on the internal and external events that hinder an organization from achieving its objectives. The framework suggests that it is critical in ERM process to identify all factors and classify them as risks or opportunities. There are four questions pertaining to event identification. Examples of the questions are: "your organization evaluated all elements affecting the achievement of the organization's objectives and strategies;" "critically evaluated the consequences of each individual risk;" and "critically evaluated the association between one type of risk to another type of risk.."

Risk assessment formed the fourth element of the framework. It emphasizes the extent to which risks are analyzed. In addition, the likelihood of the occurrence and impact towards the organization formed part of the risk assessment. An organization must have sound risk assessment to influence the decision on how a particular risk should be managed. Three questions measure the organization's risk assessment. Examples include: "evaluate the frequency of risk event", "evaluate the cost impact of risks" and the third question assesses the organization's risk evaluation techniques as suggested by the framework such as point estimate, probabilities, lost range and best/worst case scenarios.

The fifth element of the framework emphasizes the method utilized by organization in response to identify risks i.e., risk response. Four types of risks include: response of avoiding risk, accepting risk, reducing risk and sharing risk. The organization will develop a set of action plans to manage or align the entity's risk tolerance and risk appetites. Three questions specified to measure the extent of implementation of organization risk response include: "established policy to ensure risk response is effectively carried out;" "implemented the risk response policy;" and the third question measures the organization's risk response such as accepting risk, avoiding risk, sharing risk and reducing risk.

The sixth element of COSO's framework is control activities. The framework suggests for organizations to establish policies and procedures pertaining to the ERM. The most critical issues are to ensure the implementation of the ERM policy especially on risk response. There are four questions measuring organization's control activities. Examples of the questions are, "determined the control activities required to reduce risks", "evaluated all costs related to the control activities", "measured the extent of control activities reduce the probability of risk estimate" and "assessed the total risk costs, i.e., cost of risk impact and cost of control activities".

Information and communication serve as the seventh element of the framework. The framework proposed that an organization should identify, capture and communicate relevant information pertaining to ERM. There are four questions measuring the extent to which an organization establishes a system that can measure and report on ERM. Examples of the questions are, "measured actual occurrence of all risks", "measured actual cost incurred for risk response", "established periodic reporting of ERM" and "the effectiveness and overall costs of ERM processes is reported to board of directors by the CRO and other responsible executive".

Monitoring is the last element of the framework that emphasizes the double checking component of ERM implementation. The framework suggests monitoring should be an ongoing process of evaluating the implementation of ERM at all levels. There are four questions designed to measure the monitoring element of ERM. Examples of the questions include, "perform separate risk evaluations by comparing actual event occurrences with estimates", "evaluating the actual cost impact of risk sharing or reduction with the estimates", "re-assess risks identification by considering any changes on the organization's risk appetites, objectives and strategies" and the last question concerns the review of ERM estimates that was identified in the earlier stage such as risk probabilities, shared/reduced risk and cost impact.

The third section of the instrument measures the overall roles and responsibilities of internal auditors in the implementation of ERM. Although some organizations may have a separate ERM unit to focus on ERM implementation, internal auditors still have significant roles to perform in the implementation of ERM (Bowling and Rieger, 2005; IIA, 2005; Scott, Whitley, McCollum, and Salierno, 2004; Tidrick, 2005). The IIA had recently issued a Position Statement describing the roles of internal auditors in the Enterprise-wide Risk Management (IIA, 2004). Figure 3 presented the framework issued by IIA on the roles of internal auditing in ERM. The design of all questions relating to the roles of internal auditors in ERM was entirely based on the IIA Position Statement.

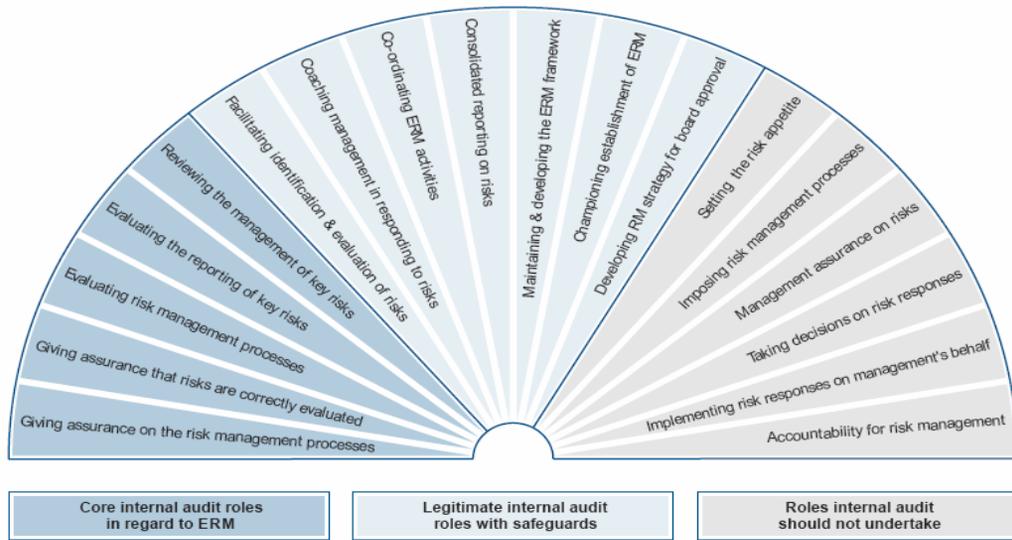


Figure 3. IIA’s Framework on Roles of Internal Auditing in ERM.

The statement identified two main roles that internal auditors should perform in ERM and one category of roles that internal auditors should not perform. Table 3 presented the 20 questions covering the three areas on internal auditor roles highlighted in the Position Statement i.e., core roles, legitimate roles and roles internal auditor should not perform.

Table 3. Questions Measuring IA’s Roles in ERM

Attribute	Question No.	The Question
Legitimate Roles	1	take the initiative to introduce the ERM to the organization.
	2	seriously promote the benefit and significance of ERM to top management team of the organization.
	3	facilitate the management to ensure the ERM framework is in accordance with the COSO’s ERM framework.
	4	coordinate and monitor all the ERM processes.
	5	provide advice on the appropriateness of an organization’s response to a particular risk.
	6	help establish the reporting line of risk in the organization.
	7	assist the management team on ways to tackle each risk.
	8	take initiative to coordinate each unit in the organization that is directly related to the ERM process.
	9	provide support or guidance to managers in identification of the best ways to mitigate risks.
Core Roles	10	provide assurance that all risks affecting the organization from achieving its objectives are identified
	11	ensure that the organization established reliable and appropriate risk management techniques

Attribute	Question No.	The Question
	12	help evaluate the probability of occurrences of each risk.
	13	ensure appropriateness of the reporting procedures of risks
	14	ensure key risks are communicated to the top management or board.
	15	ensure all internal controls are in place and functioning.
Roles IA should not Undertake	16	establish the organization's risk appetite.
	17	make all decisions related to risk response.
	18	implement all risk responses on behalf of the management team.
	19	are mainly accountable for all ERM decisions.
	20	are responsible for all documentation related to the ERM.

The roles of internal auditor in ERM are classified into core roles, legitimate roles and roles that internal auditors should not undertake. The internal auditor core roles in ERM is congruent with the assurance activities while the legitimate roles reflect the consulting activities stipulated in the new definition of internal audit (IIA, 2006a). Examples of the questions for core roles are “provide assurance that all risks affecting the organization from achieving its objectives are identified”, “ensure that the organization established reliable and appropriate risk management techniques” and “ensure key risks are communicated to top management or board”. A total of six questions are designed to tap the core roles.

The legitimate roles of an internal auditor are measured using nine questions. Examples include “take the initiative to introduce ERM to the organization”, “coordinates and monitor all the ERM processes” and “help established the reporting line of risk in the organization”. Finally the instrument also includes the roles that internal auditors should not perform in the ERM. The involvement of an internal auditor in this role would violate the independence and objectivity of the internal auditor itself. There are five questions designed to measure this construct. Examples of the questions are “established the organization's risk appetite”, “make all decisions related to risk response” and “implement all risks responses on the behalf of management team”.

The fourth section of the instrument comprises of two simple open-ended questions concerning the implementation of ERM and roles of the internal auditor in such implementation. The respondents are given the opportunity to highlight any other issues that they would like to share. They are also encouraged to share their opinion on the roles of internal auditor in the implementation of ERM. This section includes the contact information of the author. Such information is believed to be crucial for any respondents that are interested in obtaining further information about the present study.

Instrument Measurement

The previous section highlighted limitations of existing instruments which focus on the measurement method used. The new instrument should be able to anticipate all the limitations

Modified Scale 3 is considered appropriate and able to provide a high degree of data i.e., ratio data. In addition, the scale enables the respondent to indicate any number of individual questions; thus, allowing the ratio type of data to be collected. Statistically, ratio type of data is the highest quality of data permitting various tests (Keller, 2000; Salkind, 2008; Steed, 2003). Furthermore, statistician also proposed the similar scale which may warrant the collection of ratio data. Modified Scale 3 will be utilized as a measurement tool to gather quantitative data on both instruments utilized in the present study.

REVIEW OF VALIDITY

This section describes the process and procedures adopted to review the validity of the instrument. The development of the first draft of the instruments started on 1 April 2007 and was completed by 31 May 2007. On 4 June 2007 the instrument was e-mailed to Michelle Scott, Director of Research and Analysis, IIA USA mainly to review the validity of the questions measuring the intended construct. The review is critical to ensure the extent to which the instrument measures what it supposed to measure. The comments were received via email on 29 June 2007. All comments and adjustments made are corrected accordingly and the revised version was ready by 12 July 2007. Initially there were 45 questions measuring the implementation of ERM and 30 questions to measure the roles of internal auditor in the ERM.

The revised instrument was then emailed to the IIAM Technical Director for a second review on 15 July 2007. The technical director was contacted via phone on 23 July 2007 requesting status of the instrument and made crucial remarks that the instrument must be simplified. She argued that the internal audit practitioners may not be able to respond to the instrument should there be too many questions. Considering the recommendation, some of the questions that indicated redundancy or similar meaning were dropped. Finally, there were only 30 questions to measure the ERM implementation and 20 questions pertaining to the role of internal auditors in ERM.

Two separate focus group interviews were performed to improve the instruments and obtain opinions regarding other relevant aspects to be included in the instrument. The first interview was conducted on 12 June 2007 at Park Royal Hotel, Kuala Lumpur. A group of nine participants, holding Chief Audit Executive (CAE) positions, participated in the informal interview in conjunction with the IIAM's ERM training. They are required to comment on the instrument measuring ERM. Overall conclusion of the session resulted in the revision of the instrument aimed for simplicity.

The second focus group interview was conducted to support the initial interview on the 20th to 21st August 2007. A group of 22 internal auditors holding various positions and from various industries participated in the session. The session was conducted during the 2007 National Conference on Internal Auditing held at Kuala Lumpur Convention Centre. The diverse compositions of participants were expected to provide valuable comments on the instruments as well as the issues concerning the present study. The participants were asked to comment on the measurement scales and all of them did not encourage the use of Likert-based scales. The scales are said to influence respondents' decisions where they are keen not

to make any decision. For instance, in a five-point or seven-point scales, the respondents tend to indicate 3 or 4 respectively.

The second major issue raised during the session was the basis used in the development of the instruments. It was confirmed that the COSO's framework on ERM is the best and most suitable basis to measure ERM implementation. The participants of the interview session suggested the number of questions concerning a particular element should not be more than 30 simple questions.

DATA COLLECTION PROCEDURES

Data collection process is critical in evaluating the reliability of the research instrument. In the present study, data collection was executed via the Universiti Tenaga Nasional (UNITEN) accounting students who went for (pursued?) their industrial (attachment?) started on 3 December 2007. 100 students were (attached?) to various accounting firms as well as large corporations all over Malaysia for the period of six months. The students serve as an agent for distributing the research instruments to internal auditors, accountants, as well as external auditors in their attached organizations. The diverse location of the students' (attachment?) is expected to satisfy the assumption of random sampling. (attached?)

The instrument was distributed to the students on 2nd and 3rd of October 2007 at UNITEN two weeks before their final examination. During the session, the students were briefly instructed about the instruments including the characteristic of respondents they were supposed to administer.. Those students will start their industrial attachment (internship?) on December 3, 2007. Each student was provided four copies of each instrument and a return pre-paid self addressed envelope. All the instruments were printed in booklet form of A5 size (width: 14.8 cm and height: 21 cm). A total of 400 instrument measuring ERM copies were distributed in 100 A5 size envelopes. In the past, the distribution of instruments conducted by the UNITEN industrial training students revealed a steady 60 percent respond rate.

DETERMINATION OF SAMPLE SIZE

Determination of sample size for the pilot study is something that cannot be neglected. It is crucial to have an appropriate sample size before performing any factor analysis. In fact, sample size is commonly overlooked by many researches in social science (Osborne, 2004). According to Tabachnick and Fidel (2001), the use of an insufficient sample size to perform factor analysis will eventually result in the extraction of erroneous factors. There were various guidelines concerning the appropriate sample size before attempting any factor analysis. In general, large samples are better than smaller samples. Larger samples tend to minimize probability of errors, maximize the accuracy of population estimates and ultimately improve the generalization of results.

There are two recommendations for choosing a sample size, first by suggesting the minimum number of subjects or respondents and second by suggesting the ratio of subjects to items or variables. Barnett and Kline (1981) suggested that the sample size should be from a sample of 50 to 400. Another study by Comfrey and Lee (1992) reported that sample size

may be determined based on the following scales of 50- very poor; 100-poor; 200- fair; 300-good; 500- very good and 1000 or more- excellent. Ledakis (1999) further reported a minimum number of 200 is required before attempting any factor analysis.

The second approach is using the ratio of subjects to variables or items. A ratio of 15 or 30 respondents for every one variable is recommended in the study of multiple regressions where the generalization of the results is critical. With regard to factor analysis, few studies suggest a minimum subject to item ratio of at least 5:1 (Gorsuch, 1983; Hatcher, 1994). It is surprising to note that many studies utilizing factor analysis do not seriously consider these sample size guidelines. By analyzing published literature that describes the use of factor analysis by researchers, Osborne and Anna (2004) revealed that most researchers utilized a sample size which was lower than the ratio of 5:1. In addition, conclusions were drawn based on this questionable analysis. Another study that surveyed 1076 peer-reviewed, published journal articles in psychology, revealed that 40.5 percent of studies that utilized factor analysis used less than 5:1 respondent to item ratio (Costello, 2003). Considering all recommendations as well as the importance of performing factor analysis with appropriate sample size, the present study utilized a 5:1 ratio of respondent to items.

According to Osborne and Anna (2004), the determination of a sample size for pilot testing is equally important as the sample size for a study. A ratio of five respondents for every single question is considered appropriate particularly for performing factor analysis and reliability tests. The present study involved the distribution of two types of research instruments. The ERM instrument consists of two main parts which measure ERM implementation and degree of internal auditor involvement in ERM. A total of 30 questions designed to tap ERM implementation and another 20 questions for internal audit involvement in ERM. By applying the ratio suggested by Osborne, a minimum number of respondents would be 150, i.e., 30 x 5 for ERM implementation and 100, i.e., 20 x 5, for degree of internal auditor involvement in ERM. The present study involved distribution of 400 copies of instruments measuring the above two constructs which meet the suggested sample size requirement by considering 60% respond rates.

The instruments were distributed to the students 2nd and 3rd October 2007. The students started their industrial training, i.e., 3rd December 2007. In order to improve the data collection with respect to this time of inactivity, a reminder was sent to all 100 students via short messaging system (SMS) on 23 November 2007. Further, a similar reminder for students to distribute the instruments was made on 9 December 2007.

REVIEW OF RELIABILITY

This section highlights all the analysis performed in order to test the reliability of the instruments developed. The instrument is intended to measure ERM implementation which also includes the measurement of internal auditors' roles in the implementation. Detailed discussion of the reliability test, as well as factor analysis, will be presented separately for both cycle of analysis involving ERM implementation and roles of internal auditors in ERM.

STATISTICAL TEST FOR RELIABILITY

Generally, an instrument is reliable when it measures what it is supposed to measure and statistically represents the degree of its consistency. There are various statistical tests available to test the reliability of an instrument. The instrument's reliability may be assessed through the following three elements of stability, equivalence and internal consistency. Stability of an instrument refers to an extent to which the same results are obtained on multiple administrations of the same instrument. Instrument stability may be statistically test (I wasn't sure if "test" is the right word to use) using test-retest reliability. Particularly, the Spearman-Brown coefficient which involves determining the correlation between scores obtained on multiple administrations. The higher the value of the instrument's correlation coefficient, the better the instrument's stability. An instrument with $r < 0.70$ may be considered unreliable (Grout, 2002).

The second assessment of instrument reliability is the equivalence which refers to the assessment of correlation scores between multiple raters who rate the same instrument. A high correlation score indicates a highly reliable instrument (Grout, 2002). The third element used to assess instrument reliability is assessing its internal consistency which refers to the extent to which the sub-elements of an instrument measures the same construct. An example of statistical tests to determine the internal reliability are split - half reliability and Cronbach's alpha. In split-half test, the questions are split into two groups and scores for each group is correlated. However, another more well known or frequently used test of internal consistency, is coefficient alpha i.e., Cronbach's alpha which is described in considerable detail in the next paragraph.

CRONBACH'S ALPHA

It is important to understand the type of scores used in the Cronbach's alpha as a basis of interpreting the reliability of an instrument. Scores are the respondent's answer to items on an instrument which can be classified as the true score and the error score. The error score can be further categories as systematic error which is affected by the research methodology used. The second category is termed as random error due to random character of the respondents. A reliable instrument will have a smaller error (i.e., both random and systematic) component in relation to the true score component, which reflects the ratio of the true score to the total score.

Cronbach's alpha, measures the level of reliability of an instrument based on the value of alpha. A smaller value denotes a less reliable instrument (as it does not measure the true score this part confuses me). Thus, the higher value of alpha is preferred. Alpha equals 1.0 when all items measure only the true score and there is no error component while the value of alpha equals zero when only an error component was measured instead of the true score this sentence confuses me as well.

According to Garson (2008), it has become standard that a moderate cut-off value of alpha of 0.60 is common in exploratory research. However, in most cases the value of alpha should be at least 0.70 or higher in order to achieve an adequate scale (Eide, Geiger, and Schwartz, 2001; Salkind, 2008). In fact, many researchers require a cut-off of 0.80 to be

considered a good scale (Carmines, 1979). Another issue in Cronbach's alpha test is the number of items in an instrument tested. The value of alpha increases as the number of items in the scale increases; thus, indicating that an instrument with fewer items would result in lower alpha and an instrument with more items may result in higher value of alpha. Therefore, one of the methods to increase the value of alpha is by increasing the number of items in a particular instrument. It is important to note that comparison of alpha levels between scales with differing numbers of items is not appropriate.

RESULTS AND INTERPRETATION

It is important at this stage to recall that the present study involves the development of an instrument which was divided into two separate sets of ERM implementation and roles of internal auditors in ERM. The results of reliability test are summarized in Table 4.

As there are two separate instruments, two sets of reliability tests were performed to analyze the instruments' internal consistency. Cronbach's coefficient alpha was utilized for all sets of analysis. As presented in Table 4, the alpha value for ERM implementation was 0.986 which indicated very reliable measures. In addition, the test of the second instrument measuring the internal auditors' roles in ERM also revealed favorable results with alpha value of 0.990.

The above results were expected as the developments of all instruments in the present study were based on the existing well constructed framework. For example, the COSO ERM integrated framework was used as the basis to develop instruments that measure ERM implementation. In addition, the instrument measuring internal auditors' role in ERM was developed based on the IIA Position Paper on the role of internal auditors in Enterprise-wide Risk Management.

Table 4. Results of Reliability Tests

Instrument	Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items
ERM Implementation	0.986	0.992
IA Roles in ERM	0.990	0.990

FACTOR ANALYSIS

Factor analysis is a statistical approach that can be used to analyze interrelationship among large numbers of variables or items and to explain those variables based on their common underlying dimensions or factors. The analysis involved condensing the information contained in a number of original variables into the smaller set of dimensions known as factors with a minimum loss of information. In fact, it contributes to the development of reliable instruments as it tests the extent to which the questions or variables designed tap into the same construct. There are various types of factor analysis, but the present study limits the

discussion to Principal Axis Factoring (PAF) which is also known as Principal Factor Analysis (PFA) (Field, 2005; Salkind, 2008).

Factor analysis is also used to uncover the underlying structure from a set of variables. It reduces attribute space from a larger number of variables to a smaller number of variables or better known as factors. This factor will then be utilized to achieve the main research objectives. Factor analysis could be used for multiple reasons. The following are among the three main reasons for utilizing factor analysis in the present study. The first is to validate the instrument by demonstrating that its constituent items load on the same factor, and to drop proposed scale items which cross-load on more than one factor. Second, to reduce a large number of variables to a smaller number of factors for modeling purposes. Finally, factor analysis could be used to select a subset of variables from a larger set based on original variables which have the highest correlations with the principal component factors.

RESULTS AND INTERPRETATION

This section highlights the result and interpretation on factor analysis performed. The result is separated between each instrument tested and is arranged as follows: 1) ERM implementation, 2) Internal auditors' roles in ERM.

ERM Implementation: The result of correlation matrix table revealed that almost all of the variables had the value of more than 0.30 which indicate the suitability of the data set for factor analysis. This is supported by the result obtained for KMO and Bartlett's test which is 0.703 and significance at 0.000 respectively. The KMO result satisfied the requirement of value more than 0.70 for good sampling adequacy (Field, 2005). The Bartlett's test of sphericity indicated a result with a significant value of 0.000. Thus, the suitability of the data is justified.

The third procedures to determine the suitability of the correlation matrix for factor analysis involves the examination on the number of off-diagonal elements in the anti image covariance matrix. In the present study, all the measurements of sampling adequacy are well above the acceptable level of 0.50.

The fourth step is to determine the factor structure via the observation of commonalities. Zillmer and Vuz, 1995 (cited in Ledakis 1999) suggest that if the majority of the commonalities are more than 0.70, there are highly likely to obtain a more prudent factor structure. The result in the commonalities table revealed that all the variables, with the exception of item 2.6 and 2.7, indicated the value of more than 0.70.

Table 5. Factor Loadings for ERM Implementation

Factor description and variables (Loading >0.50)				
Factor	Item	The Question	Loadings	% of Variance Explained
Factor 1: Internal Risk Environment	2.19	determined the control activities required to reduce risks.	0.788	79.105
	2.9	evaluated all elements affecting the achievement of the organization's objectives and strategies.	0.786	
	2.10	critically evaluated the consequences of each individual risk.	0.723	
	2.16	established policy to ensure risk response is effectively carried out.	0.715	
	2.17	implemented the above risk response policy.	0.707	
	2.2	established procedures to suit all key stakeholders' risk appetites.	0.676	
	2.4	set responsibilities in relation to ERM for all board members and senior executives.	0.670	
	2.25	established periodic reporting of ERM.	0.665	
	2.11	critically evaluated the association between one type of risk to another type of risks.	0.664	
	2.12	established proper methods or techniques to identify risks.	0.662	
	2.8	set clear long-term objectives and strategies for every unit in the organization.	0.655	
	2.26	effectiveness and overall cost of ERM processes is reported to the board of directors by the Chief Risk Officer or other responsible executive.	0.640	
	2.20	evaluated all costs related to the control activities.	0.627	
	2.27	performed separate risk evaluations by comparing actual event occurrences with estimates.	0.626	
	2.14	evaluated the cost impact of risks.	0.615	
	2.28	evaluated the actual cost impact of risk sharing or reduction with the estimate.	0.614	
	2.3	upholds integrity and ethical values in every part of organization.	0.569	

Table 5. (Continued)

Factor	Item	The Question	Loadings	% of Variance Explained
	2.5	set up the risk committee in addition to the existing audit committee.	0.561	
	2.27	performed separate risk evaluations by comparing actual event occurrences with estimates.	0.626	
	2.14	evaluated the cost impact of risks.	0.615	
	2.28	evaluated the actual cost impact of risk sharing or reduction with the estimate.	0.614	
	2.3	upholds integrity and ethical values in every part of organization.	0.569	
	2.5	set up the risk committee in addition to the existing audit committee.	0.561	
Factor 2: Risk Quantifica- tion	2.15.3	lost range	0.841	4.029
	2.18.3	sharing risks	0.821	
	2.18.2	avoiding risks	0.741	
	2.15.4	best/ worst case scenarios	0.738	
	2.15.2	probabilities / frequency	0.692	
	2.15.1	point estimates	0.687	
	2.18.4	reducing risks	0.671	
	2.18.1	accepting risks	0.659	
	2.6	established a specific post of Chief Risk Officer to be responsible for all ERM issues.	0.573	
2.29	reassessed risk identification by considering any changes on the organization's risk appetite, objectives and strategies.	0.568		
Factor 3 Control and Communi- cation Oversight	2.22	assessed the total risk cost, i.e., cost of risk impact and cost of control activities.	0.803	3.238
	2.24	measured actual cost incurred for risk response.	0.793	
	2.23	measured actual occurrences of all risks.	0.792	
	2.30.3	Cost impact	0.741	
	2.30.2	Shared/ reduce risks	0.717	

Factor	Item	The Question	Loadings	% of Variance Explained
	2.21	measured the extent of control activities reduced the probability of risk estimate.	0.702	
	2.30.1	Risk probabilities/ frequency	0.690	
	2.1	considered and understood the risk appetites of the key groups of stakeholders.	0.621	
	2.13	evaluated the frequency of risk event.	0.574	
Cumulative variance explained				86.372

The next step is to determine the number of factors to retain in the analysis via the use of Kaiser Rule. Basically, the rule specified that factors accounting for variances greater than 1.0 should be retained. Based on the result, there are three variables with Eigen value more than 1.0. For example, factor 1 accounted for 30.060 followed by factor 2 that accounted for 1.531 and factor 3 with the value of 1.230. In addition, the total cumulative percentage of variance explained by the three factors accounted for 86.372%. Thus, the result clearly satisfied the requirement of at least 70% for social science as highlighted by Ledakis (1999).

Finally, in order to improve the model's interpretability, orthogonal rotation with Varimax rotation was performed. The result of the rotated factor matrix table is presented in Table 5. Based on the results, 18 variables or items loaded into factor 1 with the loading value range from 0.561 to 0.788. There are ten items loaded in factor 2 with the value of loadings ranging from 0.568 to 0.841. Finally, there are only nine items loaded into factor 3 with factor loadings ranging from 0.574 to 0.803. The common theme in each of the three factors was identified and a name for each factor was assigned accordingly. The term factor i.e., factor 1, 2 and 3 are now referred to as variables. Factor 1 was termed as Internal Risk Environment, factor 2 as Risk Quantification, while factor 3 was used as a Control and Communication Oversights. Thus, from the total 30 variables included in the instrument to measure the ERM implementation, factor analysis had re-grouped all the variables into three main variables as a proxy to the ERM implementation. The factor scores of these three variables i.e., Internal Risk Environment, Risk Quantification and Control and Communication Oversights will be utilized as the basis for further analysis in this study.

Roles of Internal Auditors in ERM Implementation: This instrument formed the second section in the questionnaire measuring the implementation of ERM. The result of the correlation matrix table revealed that all of the variables had the value of more than 0.30, i.e., ranging from 0.682 to 0.970, thus suitable for factor analysis. This is further supported by the result obtained for KMO and Bartlett's test which is 0.884 and significance at 0.000 respectively. The KMO result satisfied the requirement of value more than 0.70 for good sampling adequacy. The third step is to determine the suitability of the correlation matrix for factor analysis involving the examination of the number of off-diagonal elements in the anti-image covariance matrix. In the present study, all the measurement of sampling adequacy falls in a range of 0.830 to 0.948. In addition, the result in the commonalities table revealed that all the variables indicated the value of more than 0.70.

Table 6. Factor Loadings for Internal Auditors' Roles in ERM Implementation

Factor description and variables (Loading >0.50)				
Factor	Item	The Question	Loadings	% of Variance Explained
Factor 1: ERM Assurance Roles	3.15	provides support or guidance to managers to identify the best ways to mitigate risks.	0.881	83.748
	3.16	establishes the organization's risk appetite.	0.830	
	3.17	makes all decisions related to risk response.	0.821	
	3.13	ensures key risks are communicated to the top management or board.	0.790	
	3.12	ensures appropriateness of the reporting procedures of risks	0.769	
	3.14	ensures all internal controls are in place and functioning.	0.768	
	3.18	implements all risk responses on behalf of the management team.	0.760	
	3.19	are mainly accountable for all ERM decisions.	0.759	
	3.20	are responsible for all documentation related to the ERM.	0.754	
	3.90	helps evaluate the probability of occurrences of each risk.	0.741	
	3.11	takes initiative to coordinate each unit in the organization that is directly related to the ERM process.	0.730	
	3.10	assists the management team on ways to tackle each risk.	0.725	
	3.80	helps establish the reporting line of risk in the organization.	0.701	
Factor 2: ERM Consulting Roles	3.2	promotes the benefit and significance of ERM to top management team of the organization.	0.874	5.812
	3.3	facilitates the management to ensure the ERM framework is in accordance with the COSO's ERM framework.	0.866	
	3.1	takes the initiative to introduce the ERM to the organization.	0.850	

Factor	Item	The Question	Loadings	% of Variance Explained
	3.5	provides assurance that all risks affecting the organization from achieving its objectives are identified.	0.836	
	3.6	ensures that the organization established reliable and appropriate risk management techniques.	0.818	
	3.7	provides advice on the appropriateness of an organization's response on a particular risk.	0.811	
	3.4	coordinates and monitor all the ERM processes.	0.778	
Cumulative variance explained				89.560

The eigenvalue reported two factors, factor 1 accounted for 16.750 and factor 2 accounted for 1.162. The total cumulative percentage of variance explained by the two factors accounted for 89.560%. The result of rotated factor matrix table is presented in Table 6 which indicated 13 variables or item loaded into factor 1 with the loading values ranging from 0.701 to 0.881. There are seven items loaded in factor 2 with the value of loadings ranging from 0.778 to 0.874. A similar approach was utilized in determining the name of each variable by identifying their common theme. Factor 1 was termed as ERM Assurance Roles and factor 2 known as ERM Consulting Roles. The factor scores of these two variables i.e., ERM Assurance Roles and ERM Consulting Roles will be utilized as the basis for further analysis in this study.

IMPACT OF RELIABILITY RESULTS ON EXISTING FRAMEWORK

This section analyzes the implication of results obtained from factor analysis towards the existing framework. The result from ERM implementation and internal auditors' role in ERM revealed different findings from (on) the existing framework particularly on the number of structure or factors extracted.

Erm Implementation

The instrument designed to quantitatively measure the ERM implementation was developed based on the existing COSO framework on ERM (COSO, 2004). The COSO's Enterprise-wide Risk Management framework suggests eight elements in measuring the implementation of ERM. The eight elements are internal environment, objective setting, event identification, risk assessment, risk response, control activities, information and communication and monitoring. Most of previous studies that involve the use of COSO's framework on ERM (refer to table 1) fail to perform reliability tests including factor analysis on their instruments. Although, Kimbrough (2006) did provide improvement on the existing

instrument to measure ERM implementation, she does not perform any reliability test on the improved instrument. In fact, Kimbrough limits the test to validity by way of expert review.



Figure 4. COSO's ERM Framework.

The present study extends the literature by performing both validity and reliability tests on the ERM instruments. With regard to validity test, all of the experts agreed that COSO's framework on ERM is the best framework to refer in developing any ERM instrument. It is interesting to note that the results from reliability test via Cronbach's alpha justify the reliability of the present instrument. However, the results from factors analysis were not consistent or support the existing COSO's framework on ERM (COSO, 2004). There were only three factors which were defined as Internal Risk Environment, Risk Quantification and Control and Communication Oversight. It is clear that the eight elements in the existing COSO's framework on ERM are not supported by the present result. Figure 4 and 5 illustrates respectively the COSO's framework as well as the modified framework with only three factors or elements.

Notice that the eight elements presented on the face of COSO's framework was modified into three elements in the new framework termed as Modified COSO's ERM framework. The first three components on the COSO framework are Internal Environment, Objective Setting, and Event Identification. These components were regrouped and combined in the first element of the modified framework. Such a group is mainly due to majority of the questions in the instrument which initially aims to measure the three element i.e., Internal Environment, Objective Setting and Event Identification were loaded on the first factor defined in this study as Risks Environment.

Risk Assessment and Risks Response which appear as the fourth and fifth element of COSO's framework were compressed in the second factor which was defined as Risks Quantification. Finally, the third factor, termed as Control and Communication Oversight, was combined with three elements from the COSO's framework. The three elements were Control Activities, Information and Communication and Monitoring.

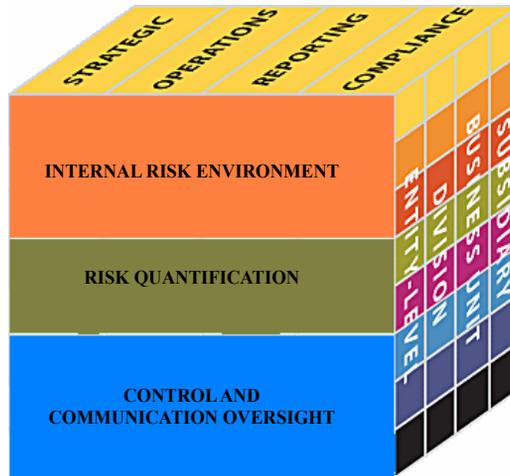


Figure 5. Modified COSO's ERM Framework.

The above result, particularly the modification of the existing COSO's framework on ERM implementation, is by itself a significant contribution to the body of literature. In contrast to the existing framework suggested by COSO, the present research setting offers a different set of findings which results in the modification of the existing framework on ERM implementation.

Internal Auditors' Roles in ERM

The second instrument was designed to measure the extent to which internal auditors discharge their roles in the implementation of ERM. There are 20 questions which were based on the IIA's Position Paper on The Roles of Internal Audit in Enterprise-wide Risk Management. The position paper categorized the roles of internal auditing into three broad categories of Core roles, Legitimate roles and roles internal auditing should not undertake (IIA, 2004). These roles were beautifully presented in fan shape as in Figure 6.

The favorable result from Cronbach's alpha justified the reliability of the instrument. However, instead of three factors as in the existing framework, factor analysis revealed only two factors. These two factors were defined as ERM Assurance roles and ERM Consulting roles. The existing framework was modified into only two segments as presented in Figure 7.

This is again another controversial finding that may stimulate more research in this field to discuss and confirm the results of present studies in different research settings. Although, IIA suggested three attributes in the framework, the present study revealed only two attributes termed as ERM Assurance Roles and ERM Consulting Roles. In fact, the present results significantly add value to the existing body of literature due to very limited research to date attempting to test the frameworks suggested by IIA.

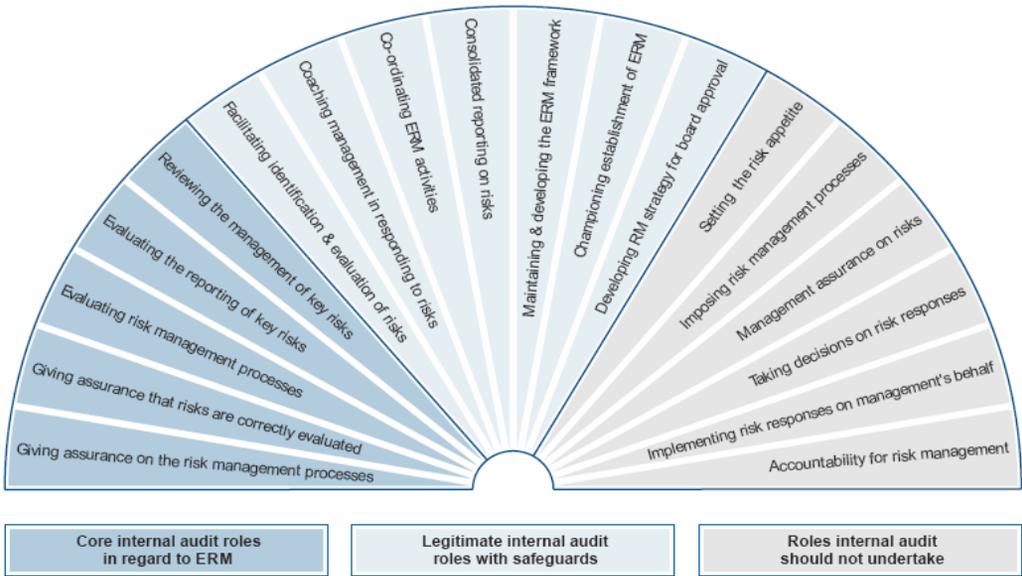


Figure 6. IIA Position Paper on Role of Internal Auditing in ERM.

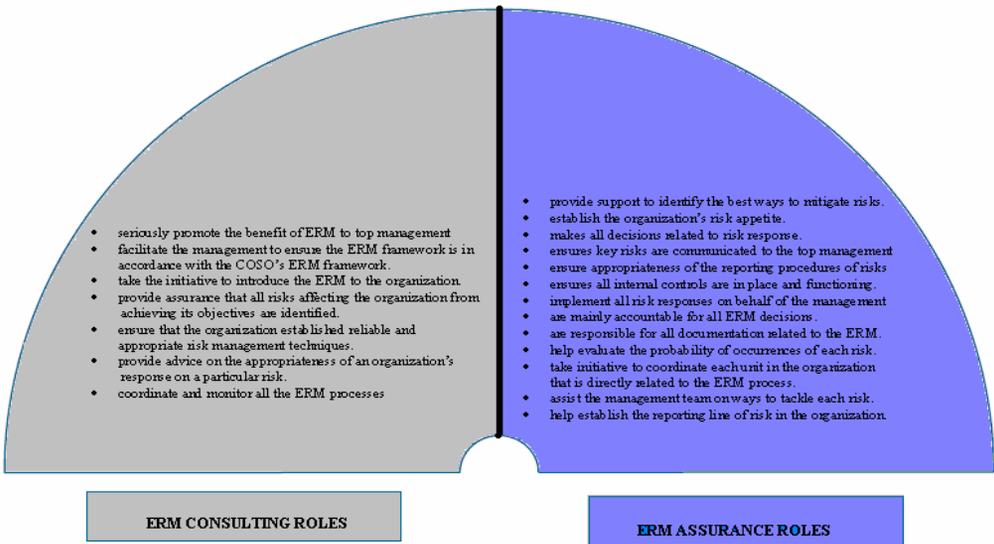


Figure 7. Modified Framework on Internal Auditing Roles in ERM.

CONCLUSION

The need for a valid and reliable instrument to quantitatively measure the ERM implementation as well as roles of internal auditing in ERM is critical. Most of the existing study did not attempt to develop an instrument that permits quantitative measure. In fact, most

of the existing instruments on ERM did not utilize COSO's framework on ERM as a basis of development. The present study narrows the gap in the literature through the development and testing of the validity and reliability of the new ERM instrument. This is by itself a significant contribution to the body of knowledge. Detail measurement and consideration was made in the development process. Results indicate that the instrument was highly valid and reliable. Moreover, the result of factor analysis alters the existing ERM frameworks proposed by COSO and IIA.

FUTURE RESEARCH

The present study limits the research setting to auditing practitioners in Malaysia and it is interesting and would be a valuable contribution to the literature if future research could test the instrument in different research settings. In addition, future research may also utilize other statistical tests to assess the reliability of the instrument.

AUTHORS' NOTE

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BIBLIOGRAPHY

- AON. (2007). Global Risk Management Survey 2007. Retrieved 16 November, 2007, from Available from: http://www.aon.comgrms2007Global_RM_Survey_07_Key_Findings1.pdf
- Barrett, P. T. K., P. (1981). The Observation to variable Ratio in Factor Analysis. *Personality Study and Group Behaviour*, 1, 23-33.
- Bowling, D. M., and Rieger, L. A. (2005). Making Sense of COSO's New Framework for Enterprise Risk Management. *Bank Accounting and Finance (08943958)*, 18(2), 29-34.
- Bruce, T. (2007, 20-21 August 2007). *External Quality Assurance: Strengthening Internal Audit's Position*. Paper presented at the 2007 National Conference on Internal Auditing, Kuala Lumpur Convention Centre.
- Carmines, E. G. a. R. A. Z. (1979). *Reliability and validity assessment*. Sage University Paper Series on *Qualitative Applications in Social Sciences*. Beverly Hills, CA: Sage publications.
- CAS. (2001). Survey on Enterprise Risk Management Report. *The Casualty Actuarial Society (CAS)*.
- Comfrey, A. L. L., H. B. (1992). *A First Course in Factor Analysis*. Hillsdale, NJ: Lawrence Erlbaum Associates.
- COSO. (2004). Enterprise Risk management- Integrated Framework. *The Committee of Sponsoring Organizations of the Treadway Commission*.

- Costello, A. L., and Lee, H. B. (2003). *Exploring best practices in factor analysis: four mistakes applied researchers make*. Paper presented at the Annual meeting of the American Educational Research Association, Chicago, Ill.
- Deloitte. (2004). 2004 Global Risk Management Survey. *Deloitte, Financial Services* Retrieved 18 September, 2007, from Available from: http://deloitte.comdttdadoccontentdttdt_financialservices_GlobalRiskManagementSurvey2005_061204-v2.pdf
- Douglas A. Lind, W. G. M., Samuel A. Wathen. (2006). *Basic Statistics for Business and Economics* (5th ed.). New York: McGraw-Hill Irwin.
- Eide, B. J., Geiger, M. A., and Schwartz, B. N. (2001). The Canfield Learning Styles Inventory: An Assessment of Its Usefulness in Accounting Education Research. *Issues in Accounting Education*, 16(3), 341-365.
- Field, A. (2005). Factor Analysis Using SPSS. Retrieved 27/2/2008, 2008, from www.sussex.ac.uk/user/andyf/factor.pdf
- Garson, D. G. (2008, 24/1/2008). Factor Analysis. Retrieved 28/2, 2008, from <http://www2.chass.ncsu.edu/garson/pa765/factor.htm>
- Garson., G. D. (2006). Logistic Regression [Electronic Version]. Retrieved 11/10/2006 from <http://www2.chass.ncsu.edu/garson/pa765/logistic.htm>.
- Gorsuch, R. L. (1983). *Factor Analysis* (2nd ed.). Hillsdale: Lawrence Erlbaum Associates.
- Grout, J. (2002). Reliability, validity and statistical analysis. Retrieved 2/10, 2006, from http://nurseweb.ucsf.edu/www/Irc_stats.pdf#
- Hatcher, L. (1994). A Step-by-Step Approach to Using the SAS System for Factor Analysis and Structural Equation Modeling. *SAS Institute Inc.*
- IACCM. (2002). Organizational Maturity in Business Risk Management. Retrieved 18 September, 2007, from Available from: <http://www.risk-doctor.compdf-filesbrm1202.pdf>
- IIA. (2003). Appraising internal audit. Retrieved 18 November 2007, from Available from: http://www.iiia.org.uk/en/search/search_Page.cfm
- IIA. (2004). Position Statement, The Role of Internal Audit in Enterprise-wide Risk management, *The Institute of Internal Auditors: The Institute of Internal Auditors*.
- IIA. (2005). COSO ERM Impact on IA. Retrieved 25 October 2007, from Available from: http://www.ucop.eduriskmgtermdocumentserm05_gain_fl_sur2004.doc.doc
- IIA. (2006a). The Professional Practices Framework, The Institute of Internal Auditors IIA.
- IIA. (2006b). Quality Assessment Manual, Tool 2, Quality Assessment Advanced Preparation. Retrieved 18 November, 2007, from Available from: www.theiia.org/download.cfm?file=19745
- IIA. (2006c). Quality Assurance and Improvement Program. Retrieved 18 November, 2007, from Available from: www.theiia.org/download.cfm?file=74520
- IIA. (2006d). Quality Assessment Manual, 5th Edition (5th ed.): The Institute of Internal Auditors.
- IIA. (2007). IIA Standard 1312- External Quality Assessments: Results, Tools, Techniques and Lessons Learned. Retrieved 18 November, 2007, from Available from: <http://www.theiia.org/research/research-reports/chronological-listing-research-reports/downloadable-research-reports/?i=261>
- IIAM. (2007). 2007 Best Internal Audit Practice Award (BIAPA). *The Institute of Internal Auditors Malaysia*.

- Jacqueline Ann, B. (2004). A critical evaluation of academic internal audit. *Quality Assurance in Education*, 12(3), 128.
- Joy, S. C. a. P. (2006). Meeting the Challenge: Enterprise Risk management Survey May 2006. *Strategic Risk*, 38-40.
- Keller, B. W. G. (2000). *Statistics for management and economics* (5th ed.). CA: Duxbury, Thomson Learning.
- Kimbrough, R. L. (2006). *The relationship between perceptions of organizational culture and implementation of enterprise risk management*. Unpublished Ph.D., The University of Alabama in Huntsville, United States -- Alabama.
- KPMG. (2005). Strategic Risk Management Survey. *KPMG*, 2007.
- Ledakis, G. (1999). *Factor Analytic Models of the Mattis Dementia Rating Scale in Dementia of the Alzheimer's Type and Vascular Dementia Patents.*, Drexel University.
- Osborne, J. W. A. B. C. (2004). Sample size and subject to Item ratio in principal components analysis. *Practical Assessment, Research and Evaluation*, 9(11).
- PCG. (2005). Catalyzing GLC Transformation to Advance Malaysia's Development. Retrieved 18 March, 2006, from <http://www.pcg.gov.my/news.asp>
- Protiviti. (2005). U.S. Risk Barometer: Survey of C-Level Executives with the Nation's Largest Companies. *Protiviti, Independent Risk Consulting*, 2007.
- PWC. (2004). Enterprise Risk Management (ERM) Benchmarking Survey 2004.
- PWC. (2006). Market Survey Internal Audit Getting Ready for Quality Assurance Review. Retrieved 18 November 2007, 2007, from <http://www.pwc.com/cz/eng/ins-sol/publ/IAmarket.pdf>
- RMA. (2006). Enterprise Risk management Survey, 2006. *The Risk Management Association (RMA)*.
- Salkind, S. B. G. a. N. J. (2008). *Using SPSS for Windows and Macintosh analyzing and understanding Data* (5th ed.). Upper Saddle River, New Jersey: Pearson Education.
- Sciarras, D. (2006a). Quality Staff Survey. Retrieved 18 November, 2007, from Available from: www.theiia.org/download.cfm?file=15317
- Sciarras, D. (2006b). Quality Client Survey. Retrieved 18 November 2007, from www.theiia.org/download.cfm?file=76048
- Scott, A., Whitley, J., McCollum, T., and Salierno, D. (2004). COSO ERM Framework Released. *Internal Auditor*, 61(5), 17-21.
- Steed, S. J. C. a. L. G. (2003). *SPSS Analysis without anguish, version 11.0 for windows* (Version 11.0 ed.): John Wiley and Sons Australia.
- Tabachnick, B. G. F., L. S. (2001). *Using Multivariate Statistics* (4th ed.). New York: Harper Collins.
- Tidrick, D. E. (2005). A Conversation with COSO Chairman Larry Rittenberg, *CPA Journal* (pp. 22-26): New York State Society of CPA's.
- Wechster, P. (2007). 2006 Enterprise Risk Management Survey. *Treasury and Risk*, 2007.
- Yarnold, B. a. (1995). Principle components analysis and exploratory and confirmation factor analysis. In *Reading and understanding multivariate analysis*: American Psychological Association Books.

Chapter 14

INTERACTION PATTERNS OF SOCIOTROPIC AND AUTONOMOUS INDIVIDUALS

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ABSTRACT

Sociotropy and autonomy are conceptualized as two personality dimensions that relate to an individual's vulnerability to depression (Beck, 1987). Sociotropy is characterized as an excessive investment in interpersonal relationships and autonomy is characterized as an excessive concern with personal achievement and control over the environment. The present research project consisted of two studies examining the relationships between sociotropy-autonomy and interpersonal patterns in close relationships. The purpose of Study 1 was to examine the interpersonal problems that sociotropic and autonomous individuals tend to experience with close others using self-report questionnaires. The goal of Study 2 was to move beyond the method of self-report questionnaires and to actually observe the interpersonal behaviors of individuals with varying levels of sociotropy and autonomy. The findings of both studies suggested that highly sociotropic individuals display more behaviors that are low in affiliation and high in dominance than individuals low in sociotropy. Furthermore the results also suggested that highly autonomous individuals display more behaviors that are low in affiliation and low in dominance than individuals low in autonomy. These findings will be discussed in the context of the literature regarding the interpersonal characteristics of sociotropic and autonomous individuals.

Keywords: *Personality, Interpersonal theory, Social interaction, Affective disorders*

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INTERACTION PATTERNS OF SOCIOTROPIC AND AUTONOMOUS INDIVIDUALS

Because major depression is one of the most common forms of psychological disturbances, considerable effort has been devoted to understanding its causes. Many attempts using a variety of approaches including biological, cognitive, psychodynamic, and interpersonal approaches have been taken in order to examine this issue (e.g., McCann and Endler, 1990; Joiner and Coyne, 1999). Past work by Beck (1967, 1976) has emphasized cognitive factors in the etiology and maintenance of depressive symptoms. These cognitive factors are described as biases that cause inappropriate self-blame and self-criticism, distorted self-images, and a high emphasis on negative aspects of events and negative expectations (Beck, 1967; Beck, Rush, Shaw, and Emery, 1979). Beck and his colleagues examined these cognitive biases and suggested some individual difference variables that might contribute to the nature of these biases and, consequently, to depressive symptoms (Beck, Epstein, and Harrison, 1983a). These individual difference variables are presently known as the personality dimensions of sociotropy and autonomy (Beck, 1983). Beck and his colleagues (Beck et al., 1983a; Beck, Epstein, Harrison, and Emery, 1983b) suggested that these two dimensions of personality may influence a person's vulnerability to depression.

The two personality dimensions, sociotropy and autonomy are conceptualized in the following manner. Highly sociotropic individuals are characterized as emphasizing interpersonal interactions involving intimacy, sharing, empathy, understanding, approval, affection, protection, guidance, and help. Individuals who are sociotropic tend to place importance on seeking approval from others and on trying to avoid disapproval from others as much as possible (Beck, 1987). In contrast, autonomy is considered to be a combination of beliefs, behavioral dispositions, and attitudes that draw an individual to invest in one's self for one's own uniqueness, mastery over one's bodily functioning, and control over one's environment (Beck, 1987). A highly autonomous person is characterized as emphasizing individuality, self-reliance, and a sense of power to do what one wants. Individuals who are autonomous tend to place great importance on self-definition, and individualistic goals, which include characteristics such as the tendency to emphasize one's own needs and rights (Beck, 1987).

According to Beck (1987), individuals who are either highly sociotropic or highly autonomous will be vulnerable to depression when faced with a threat or a loss in a domain corresponding to their specific type of individual investment. For example, a loss of a significant person in one's life may lead to depression in a sociotropic individual, but would be less likely to have such an effect in an autonomous individual (Clark, Beck, and Brown, 1992; Hammen, Ellicott, Gitlin, 1992; Hammen, Ellicott, Gitlin, and Jamieson, 1989; Kwon and Whisman, 1998; Robins and Block, 1988). On the other hand, repeated failure in performing a personal task may be more likely to lead to depression in an autonomous individual than in a sociotropic individual (Hammen, Ellicott, and Gitlin, 1989; Clark and Oates, 1995; Robins, Hayes, Block, Kramer, and Villena, 1995). Research testing this diathesis-stress model seems to provide general support for both the sociotropy and autonomy dimensions (see Coyne and Whiffen, 1995; Nietzel and Harris, 1990; Robins, 1995; Sato and McCann, 2002; Zuroff, Mongrain, and Santor, 2004; Zuroff, Santor, and Mongrain, 2005, for reviews and recent developments).

Most of the past work in this area has evaluated the accuracy of the diathesis-stress model described above. While a great deal of attention has been directed at evaluating this diathesis-stress model (see Coyne and Whiffen, 1995; Zuroff, Mongrain, and Santor, 2004), much less attention has been devoted to considering other implications of these personality vulnerabilities. In the present research we examined some of the interpersonal characteristics of sociotropy and autonomy, two vulnerabilities originally discussed by Beck (1983). Recently, there has been some attention directed to a consideration of the nature of sociotropy and autonomy with regards to interpersonal relationships and behavior patterns (e.g., Alden and Bieling, 1996; Bieling and Alden, 2001; Lynch, Robins, and Morse, 2001; Murphy and Bates, 1997; Sato 1999; Sato and McCann, 2001; Zuroff and Fitzpatrick, 1995). Recent work in this area has suggested that both sociotropic and autonomous individuals may exhibit divergent dysfunctional interpersonal patterns (Alden and Bieling, 1996; Bieling and Alden, 2001; Lynch et al., 2001; Sato, 1999; Sato and McCann, 2007) that may trigger the onset of depression and perhaps serve to maintain the depressive symptoms.

This line of work seems to have some parallels with other research on depression suggesting that being depressed, vulnerable, or insecure increases interpersonal stress which, in turn, serves to maintain and exacerbate the depressive symptoms (Coyne, 1976; Hammen, 1991, 1992; Hankin and Abramson, 2001; Joiner, Alfano, and Metalsky, 1992). Hammen (1991), for instance, proposed that both personality (including interpersonal behavior patterns) and depressive symptomatology may explain this stress generation process. She argued that an individual's personality, mood and interpersonal behavior patterns may contribute to a more stressful environment, which consequently contributes to the onset and maintenance of depression (Hammen, 1991, 1992). Interestingly, some researchers examining the nature of sociotropy and autonomy have also turned their attention to how these personality traits relate to interpersonal behavior patterns (e.g., Alden and Bieling, 1996; Bieling and Alden, 2001; Lynch, Robins, and Morse, 2001; Murphy and Bates, 1997; Sato 1999; Sato and McCann, 2001; Shih, 2006; Zuroff and Fitzpatrick, 1995). For example, to examine whether the interpersonal stress was caused by the depressive symptoms or more enduring interpersonal patterns characteristic of the individual's personality, Shih (2006) conducted a longitudinal study examining individuals who are vulnerable to depression. It was found that, among women, high levels of sociotropy seem to be predictive of interpersonal stress, which in turn predicts an increase in depressive symptoms (Shih, 2006).

Other work in this area has suggested that both sociotropic and autonomous individuals may exhibit divergent dysfunctional interpersonal patterns that may trigger the onset of depression and perhaps serve to maintain the depressive symptoms (Alden and Bieling, 1996; Bieling and Alden, 2001; Lynch et al., 2001; Sato, 1999; Sato, Grookett, Lyons, Scott, and Torquato, 2002; Sato and McCann, 2007). For instance, by using various self-report questionnaires, Lynch and his colleagues investigated depressed people with high levels of sociotropy or autonomy and their interpersonal interactions in intimate relationships (Lynch et al., 2001). The researchers found that depressed individuals who scored high on sociotropy rated themselves as being highly demanding and rated their partner as withdrawing. Although it may seem counterintuitive that highly sociotropic individuals behave in demanding ways, Lynch and his colleagues suggested that these individuals may become more demanding in an attempt to experience greater closeness with their partners (Lynch et al., 2001). On the other hand, depressed individuals scoring high on autonomy reported themselves as withdrawing while rating their partners as demanding (Lynch et al., 2001). The relationship between

autonomy and withdrawing behaviors seems to be consistent with other literature claiming that highly autonomous individuals have a tendency to focus on their personal goals and prefer solitude (Beck, 1987; Clark, Steer, Beck, and Ross, 1995). Taken together, these findings suggest that one's level of sociotropy and autonomy can influence vulnerability for depression by negatively affecting interpersonal interactions in intimate relationships (Lynch et al., 2001).

STUDY 1

Study 1 was designed to investigate the interpersonal problems associated with sociotropy and autonomy during interactions by using the Interpersonal Circumplex Model (Leary, 1955). The Interpersonal Circumplex Model is a theoretical framework commonly used to examine the social tendencies of individuals (Alden, Wiggins, and Pincus, 1990; Hill and Safran, 1994; Wiggins, 1995). According to Leary (1955, 1957), the originator of the Interpersonal Circumplex Model, social behaviors can be conceptualized by using a circle placed on two orthogonal dimensions (see Figure 1). One of these dimensions is labeled affiliation (horizontal dimension) and ranges from Excessive Nurturance on the one end to Coldness on the other. The other dimension is labeled control (vertical dimension) and ranges from Dominance to Nonassertiveness (Alden, Wiggins, and Pincus, 1990; Kiesler, 1982, 1983, 1996; Leary, 1957; Wiggins and Broughton, 1985). As can be seen in Figure 1, the Interpersonal Circumplex is commonly divided into eight sections labeled in relation to its location on the two dimensions. According to this model, an individual's social tendencies are conceptualized as corresponding to a certain section of the circle.

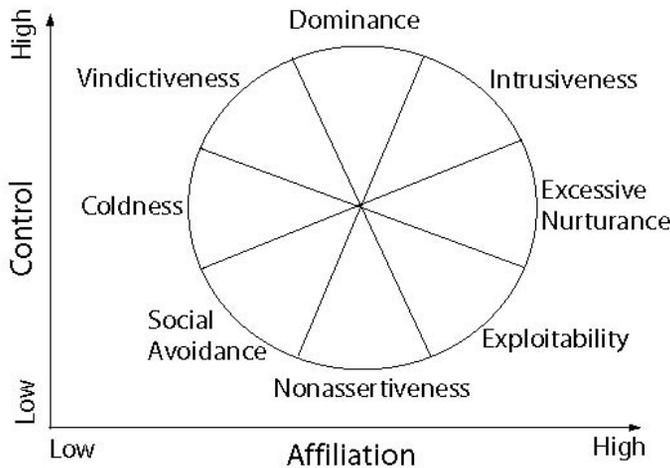


Figure 1. Interpersonal Circumplex Model.

The Interpersonal Circumplex Model, however, assumes a great deal more about our personalities than where each individual would be placed on these two dimensions. Leary

(1955, 1957) claims that individuals tend to repeat interpersonal patterns by consistently acting in a specific manner and drawing others to respond to them within a constricted range of actions which are complementary to their own actions. According to this theory, complementarity occurs on the basis of; (1) "correspondence" on the affiliation dimension and (2) "reciprocity" on the control dimension. In other words, nurturance is complementary to nurturance as coldness is to coldness (i.e., correspondence). Dominance, however, is complementary to nonassertiveness and vice versa (i.e., reciprocity). Therefore, any combination of control and affiliation will invite a corresponding complementary response from others. For example, by behaving in a dominating and cold manner toward my brother I invite a nonassertive and cold response from him. As a consequence, my brother responds in a nonassertive and cold way and this response invites a dominating and cold response from me again. My dominating and cold response again, invites a nonassertive and cold response from my brother and this interpersonal cycle can continue repeating itself. Thus, according to this model, a person's interpersonal behavior is designed to produce reactions from others that confirm the perceptions, expectations, and construals of others as well as the self (Carson, 1982). In addition to complementarity in the type of behavior, complementarity also occurs in the intensity of behavior (Kiesler, 1983). For example, an intensely cold response will most likely elicit an equally intensely cold response. Likewise, a moderately dominant action will most likely elicit a moderately nonassertive response. Complementary responses are made to sustain a natural interaction and allow an unfolding of events in an unbroken causal chain. Interpersonal theorists such as Carson (1979) and Kiesler (1996) claim that people tend to invite complementary responses from others in order to affirm and validate our chosen interpersonal style of living. Many scholars in the interpersonal field often discuss how our specific interpersonal behavior patterns constitute a large part of their personality (Leary, 1955; Sullivan, 1953).

In order to assess one's interpersonal tendencies in the context of the interpersonal circle, Alden, Wiggins, and Pincus (1990) developed a measure known as the Inventory of Interpersonal Problems-revised. The Inventory of Interpersonal Problems-revised is designed to assess interpersonal problems in eight categories corresponding to eight sections of the interpersonal circle discussed above. It consists of eight measures each consisting of eight Likert scale items. Research using the revised version of the Inventory of Interpersonal Problems (Alden et al., 1990) suggests that sociotropic and autonomous individuals tend to have divergent interpersonal problems that may contribute to the etiology and maintenance of depression (e.g., Sato and McCann, 2001, 2007). For example, individuals who were highly sociotropic were found to expect themselves to act in a vindictive manner toward people who are close to them (Sato, 1999; Sato, et al., 2002; Sato and McCann, 2007). Although it may seem counterintuitive that highly sociotropic individuals behave in vindictive ways, Sato and McCann (2007) suggested that when highly sociotropic individuals are already close to someone, they may feel that a high level of relatedness may be maintained even if they behave in vindictive ways. Regardless of personality, we all take certain liberties with close others such as spouses, parents, children, other family members, and close friends because we know that we will still be accepted and thus be able to maintain a high level of relatedness with them even if we are not on our best behaviors. These researchers suggest that perhaps this tendency for highly sociotropic individuals is an exaggerated version of this common tendency that we all have. In addition, recent research findings have also revealed that highly autonomous individuals expect themselves to be socially avoidant toward those close to them

(Sato, 1999; Sato et al., 2002; Sato and McCann, 2007). This relationship between autonomy and social avoidance seems to be consistent with other literature claiming that highly autonomous individuals have a tendency to withdraw from close others and prefer solitude (Beck, 1987; Clark et al., 1995; Lynch et al., 2001).

Other researchers have investigated the interaction tendencies of sociotropic and autonomous individuals with non-specific others. For instance, research by Alden and Bieling (1996) suggests that a high level of sociotropy is related to being non-assertive and exploitable whereas a high level of autonomy is related to being cold and socially avoidant toward others. Sato and McCann's (2001) findings, in contrast, suggested that a high level of sociotropy is related to being excessively nurturant and exploitable whereas a high level of autonomy is related to being too domineering and vindictive toward other people.

In sum, although scholars utilizing the interpersonal approach have suggested that depressive individuals tend to interpret social information in unique ways and have distinct interpersonal interaction tendencies relating to these interpretations (e.g., Coyne, 1976; Joiner, Alfano, and Metalsky, 1992; Joiner and Coyne, 1999; Libet and Lewinsohn, 1973; Youngren and Lewinsohn, 1980; McCann, 1990a, 1990b; McCann and Lalonde, 1993; McCann and Segrin, 1996), there is some disagreement concerning the distinct interaction tendencies associated with sociotropy and autonomy. Due to the importance of understanding the key elements in the etiology and maintenance of depression, the present research project was designed to explore this issue of interpersonal characteristics relating to sociotropy-autonomy in further detail.

The first study was designed to investigate the interpersonal problems associated with sociotropy and autonomy during interactions with close others. Since we all spend a large portion of our lives interacting with individuals close to us, it is important to understand how these interactions might be related to the etiology and maintenance of depression. Investigation of these types of interpersonal problems is especially relevant for individuals with high levels of sociotropy and autonomy.

It has been suggested that one key factor leading to some of the divergent findings concerning the interaction tendencies associated with sociotropy and autonomy may be the variability in the relationships sociotropic and autonomous individuals have with the person they are interacting with (e.g., Sato and McCann, 2007; Sato, et al., 2002). It is evident from our own experiences that we behave differently toward close others than we do toward strangers and mere acquaintances. Although the original Inventory of Interpersonal Problems-revised (Alden et al., 1990) instructs individuals to respond by thinking about relationships with any significant person in one's life, many individuals do not seem to picture a specific person when completing the questionnaires (some do not read the instructions thoroughly before they begin completing the questionnaire). This leads to some individuals responding to these items focusing on how they interact with strangers and mere acquaintances while other individuals responding by focusing on how they interact with individuals close to them such as romantic partners, parents, and friends. In order to minimize the variability regarding the type of relationship the respondents are focusing on, we asked participants to first visualize a particular person they feel closest to and write that person's initials on the questionnaire. The participants were then asked to complete the Inventory of Interpersonal Problems-revised (Alden, et al., 1990) focusing on their relationship with that particular person.

As mentioned earlier, recent research using the Interpersonal Circumplex Model has suggested that individuals who are highly sociotropic may have the tendency to be vindictive

to people who are close to them and highly autonomous individuals may be socially avoidant toward those close to them (Sato, 1999; Sato et al., 2002; Sato and McCann, 2007). Other research not using the Interpersonal Circumplex Model has revealed that depressed individuals who are high in sociotropy tend to be highly demanding while depressed individuals who are high in autonomy tend to be withdrawing in the presence of close others (Lynch et al., 2001). If we examine the eight sections of the Interpersonal Circumplex, the term closest to "demanding" may be intrusiveness and dominance and the term closest to "withdrawing" may be social avoidance. Since these interpersonal problems do not match entirely with the research findings using the Interpersonal Circumplex Model by Sato and his colleagues (Sato, 1999; Sato et al., 2002; Sato and McCann, 2007), the present study was designed to examine the interpersonal problems of sociotropic and autonomous individuals further. Due to the past findings discussed above, we made the following general hypotheses: (a) that highly sociotropic individuals have problems being too vindictive, dominant, or intrusive toward those close to them and (b) that highly autonomous individuals have problems being socially avoidant toward close others.

METHOD

Participants and Procedure

Although depression is a clinical phenomenon, the theory of sociotropy and autonomy is focused on individuals who are vulnerable to depression and not necessarily individuals who are currently depressed. In order to promote the prevention of depression, we need to develop a better understanding of individuals with a wide range of vulnerability levels. We therefore examined a non-clinical undergraduate student population. One hundred and fifty-seven (72 male, 85 female) undergraduate university students recruited from introductory psychology courses participated in the study. The mean age of the participants was 20.6 (range 18-32) years. All participants were asked to report to a laboratory, sign a participant consent form, and complete two questionnaires. They were (a) the Sociotropy-Autonomy Scale (Clark, et al., 1995) and an adapted version of the Inventory of Interpersonal Problems-revised (Alden et al., 1990). The responses of the participants were anonymous and participation was voluntary. Participants were fully debriefed following completion of the questionnaires.

Measures

Sociotropy-Autonomy Scale. The Sociotropy-Autonomy Scale is a commonly used measure for assessing one's level of sociotropy and autonomy (Clark et al., 1995; Clark, Steer, Haslam, Beck, and Brown, 1997; Sato, 1999, 2003; Sato and McCann, 1997, 1998, 2000). This questionnaire consists of one scale for sociotropy and two scales for autonomy (Clark et al., 1995). The sociotropy measure consists of twenty-eight items. The two autonomy scales are labeled: (1) solitude, and (2) independence. The solitude scale consists of thirteen items and the independence scale consists of seventeen items. Past research using the Sociotropy-Autonomy Scale has suggested that the "independence" measure is unrelated to

vulnerability to depression (Bieling, Beck, and Brown, 2000; Clark et al., 1995; Clark et al., 1997; Sato, 1999; Sato and McCann, 1997, 1998, 2002). Due to these findings, the present research will focus on the solitude scale as a measure for autonomy.

The Sociotropy-Autonomy Scale requires participants to respond to each of the items on a five-point frequency scale from "never" to "all of the time". Scores are calculated separately for each of the three dimensions. All three measures have acceptable internal consistency (Cronbach alphas: Sociotropy .87, Solitude .70, Independence, .76) and temporal stability within 4-6 weeks (see Clark, et al., 1995).

Adapted Version of the Inventory of Interpersonal Problems-revised. The Inventory of Interpersonal Problems-revised (Alden et al., 1990) was designed to assess interpersonal problems in eight categories corresponding to eight sections of the interpersonal circle (Figure 1). The eight measures used to assess the eight categories are labeled as: dominance, vindictiveness, coldness, social avoidance, nonassertiveness, exploitability, excessive nurturance, and intrusiveness. Each of the eight measures consists of eight items describing interpersonal problems corresponding to a specific section of the interpersonal circle. The Inventory of Interpersonal Problems-revised requires participants to respond to each item on a five-point rating scale indicating how distressing each problem (represented by each item) is for them in relationships with significant people in their life. The scale ranges from "not stressful at all" to "extremely stressful". Scores are calculated separately for each of the eight dimensions. All eight measures have good internal consistency (Cronbach alphas ranging from .72 to .85; see Alden, et al., 1990 for details). Temporal stability of this scale has not been investigated at this point.

In order to insure that the participants' responses were based on a relationship with someone significant in their life, this version of the Inventory of Interpersonal Problems-revised used in the present research was slightly altered. For this version, the participants were first asked to decide on a particular person that they feel closest to, such as a romantic partner, mother, sibling, or best friend and indicate the person's initials and their relationship with that person on the questionnaire. After they specified the person they feel closest to, they were asked to rate how distressing each problem (represented by each item) is in the particular relationship with that person. Participants responded to all items of the Inventory of Interpersonal Problems-revised.

RESULTS

Psychometric Properties of the Measures

The Cronbach alphas, means, and standard deviations of the two primary measures used in the Sociotropy-Autonomy Scale (Sociotropy and Solitude) are listed in Table 1. These figures are comparable to previous research using this scale (Clark et al., 1995; Sato, 2003). The eight measures of the variation of the Inventory of Interpersonal Problems-revised (Alden et al., 1990) revealed good reliability values. The Cronbach alphas all of the scales are listed in Table 1. These results are comparable to the findings in previous studies using the same scale (Sato and Gonzalez, in press; Sato and McCann, 2007). The means and standard deviations of these measures are listed in Table 1. Of the 157 participants, 50% of them

described their close other as a romantic partner or spouse, 34% as a best friend, 7% as their mother, 4% their sibling, and 5% of them described them in a variety of other ways.

Table 1. Means, Standard Deviations, and Correlations for Sociotropy-Autonomy and Interpersonal Problems

Variable	Cronbach α	Mean	SD	Sociotropy	Autonomy
Sociotropy	.88	64.68	16.27	1.00	.33**
Autonomy (Solitude)	.71	19.82	6.57	.33**	1.00
Dominance	.81	6.75	5.06	.35**	-.08
Vindictiveness	.78	7.65	5.17	.40**	.13
Coldness	.86	7.01	5.73	.27**	.28**
Social Avoidance	.83	9.41	6.68	-.08	.40**
Nonassertiveness	.87	10.56	6.74	-.05	.25*
Exploitability	.81	11.12	6.02	-.08	.14
Excess Nurturance	.76	11.95	5.75	.15	.06
Intrusiveness	.75	8.64	5.44	.22*	-.02

* $p < .05$, ** $p < .01$

Note: $N = 157$

Correlations

The correlations between sociotropy-autonomy and all of the variables concerning interpersonal problems are presented in Table 1. The results of the correlations between sociotropy and interpersonal problems suggested that, high sociotropy may be related to being too intrusive, too vindictive, too domineering, and too cold. The correlations between autonomy and interpersonal problems with a close person also suggested that high autonomy (solitude) may be related to being too cold, socially avoidant, and too nonassertive. Figure 2 is of a radar graph of the correlations reported in Table 1 contrasting the interpersonal problems sociotropic and autonomous individuals have with close others. From this figure, we can see that although there is some overlap, sociotropic and autonomous individuals tend to have different interpersonal problems with close others.

DISCUSSION

One of the major objectives of this research project was to explore the distinct interaction tendencies associated with sociotropic and autonomous individuals. In support of previously found evidence (Alden and Bieling, 1996; Bieling and Alden, 1998; Lynch et al., 2001; Sato, 1999; Sato and McCann, 2001), the findings of Study 1 suggest that sociotropic and autonomous individuals have divergent interpersonal patterns that are problematic when dealing with close others. Study 1 revealed that high sociotropy may be related to being too intrusive, too vindictive, too domineering, and too cold.

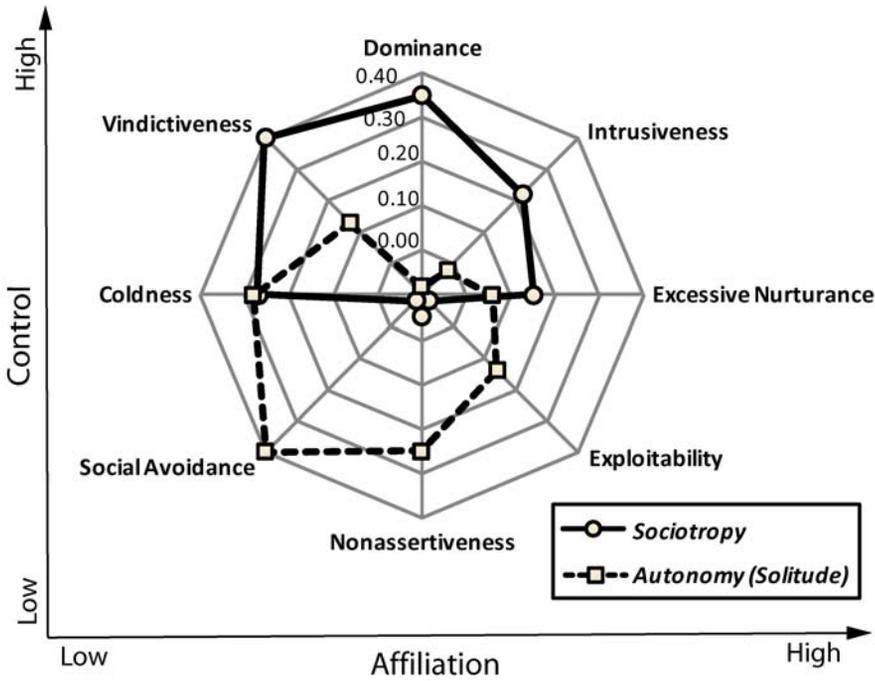


Figure 2. Correlations between Sociotropy-Autonomy and Interpersonal Problems.

These interpersonal patterns associated with sociotropy cluster around the top-left (High Control-Low Affiliation) section of the interpersonal circle (see Figure 2). The present study also revealed that high autonomy (solitude) may be related to being too cold, socially avoidant, and too nonassertive. These interpersonal patterns associated with autonomy cluster around the bottom-left (Low Control-Low Affiliation) section of the interpersonal circle (see Figure 2). Moreover, although not all of the relationships above were initially hypothesized, some of the correlations relevant to our hypothesis (i.e., sociotropy - vindictive, dominant, or intrusive and autonomy - socially avoidant) were found to be significant.

Despite some variations in the findings, the results of Study 1 resemble the findings of other research projects focusing on relationships with specific close others (e.g., Lynch et al., 2001; Sato et al., 2002). The work by Lynch and his colleagues (Lynch et al., 2001) as well as the results of Study 1 suggest that highly sociotropic individuals tend to behave in "demanding" or dominant ways and autonomous individuals tend to behave in "withdrawing" or socially avoidant ways. Most importantly, if we examine the radar graphs in Figure 2, the interpersonal problems correlating with sociotropy gradually rise until they peak at vindictiveness. In contrast, the interpersonal problems correlating with autonomy gradually rise until they peak at social avoidance. These findings are very similar to previous work by Sato and his colleagues (Sato et al., 2002; Sato and McCann, 2007).

Since people are sometimes known to behave differently from how they claim they behave in questionnaires (LaPiere, 1934; Wicker, 1969), the next study was designed to investigate whether sociotropic and autonomous individuals not only expect themselves to behave in these ways, but actually do behave in these ways toward specific people they are close to in their everyday lives.

STUDY 2

Due to the importance of understanding the key elements in the etiology and maintenance of depression, Study 2 was designed to further clarify the interpersonal characteristics relating to the personality dimensions of sociotropy and autonomy. Past research regarding the interpersonal patterns of sociotropic and autonomous individuals has been based on self-report questionnaires, rather than on direct observations of actual interpersonal behavior (Alden and Bieling, 1996; Bieling and Alden, 1998; Lynch, Robins, and Morse, 2001; Sato, 1999; Sato et al., 2002; Sato and McCann, 2001). These studies typically assume that we are aware of our own interpersonal behaviors and that we are willing and able to accurately report our own interpersonal behaviors.

Therefore, in Study 2 we sought to directly observe interpersonal interactions of individuals with varying levels of sociotropy and autonomy. In order to examine how these individuals actually behave towards people they are close to in their everyday lives, we examined the actual interactions of these individuals with their romantic partners. Thus, the goal of the present study is to investigate whether sociotropic and autonomous individuals not only expect themselves to behave in certain ways toward close others, but actually do behave in these ways when they interact with their romantic partners. Since the interpersonal patterns associated with sociotropy cluster around the top-left (High Control-Low Affiliation) section of the interpersonal circle and those associated with autonomy cluster around the bottom-left (Low Control-Low Affiliation) section of the interpersonal circle (see Figure 2), we hypothesized that sociotropic individuals tend to behave in a manner considered to be high in control and low in affiliation and highly autonomous individuals tend to behave in a manner that would be considered low in control and low in affiliation.

METHOD

Participants

Participants were recruited from numerous undergraduate Psychology classes. The students in these classes were informed that in order to be eligible to participate, they must presently be in a romantic relationship that has lasted for three months or longer. As a result, 110 undergraduate university students volunteered and reported to a laboratory with their romantic partners at appointed times. Although, this was not specified at the recruitment process, all of the couples volunteering for this study were heterosexual. A total of 220 participants (110 male, 110 female) with a mean age of 20.9 (range 18-45) years participated in Study 2.

Procedure

Upon arrival to the laboratory and signing the participant consent form, both individuals in the romantic relationship were requested to independently complete a brief survey regarding how long the participants have been in their relationships with their romantic

partners and how satisfied they are with this relationship. The participants were then asked to complete the Sociotropy-Autonomy Scale (Clark, et al., 1995). Upon completion of the Sociotropy-Autonomy Scale, each participant (i.e., both individuals in the romantic relationship) was asked to rank order eight areas of conflict in their relationship independently of each other (disagreement in preferred activities, disagreement in preferred friends, opposing political / philosophical / religious beliefs, lack of understanding / sensitivity, amount of time spent together, feeling that one person is too demanding, disagreement concerning money, disagreement concerning sexual behaviors). The area of conflict ranked highly by both partners and ranked highest in importance by the woman was chosen as the topic of discussion. If there were no common problems, the problem listed as highest by the woman was chosen. If either of the participants felt uncomfortable discussing the top choice, the next ranked topic was chosen. The participants were then asked to discuss the topic for ten minutes. With the participants' consent, the discussion was videotaped in the absence of the experimenter. After eight minutes of discussion, the experimenter entered the room, stopped the videocamera and informed the participants that the discussion session was over. The participants were then fully debriefed and thanked for their participation. This procedure of choosing a topic of discussion between romantic partners and videotaping the discussion is a common procedure used in studies investigating the interactions between romantic partners (see Mongrain, Vetteese, Shuster, and Kendal, 1998; Zuroff and Duncan, 1999).

Measures

Relationship Duration and Satisfaction. Participants had four response choices regarding the length of their romantic relationship; less than 6 months, 6-12 months, 1-2 years, and more than 2 years. Satisfaction of their present romantic relationship was rated on a five-point scale from very unsatisfied (1) to very satisfied (5). Each partner responded to these questions independently of each other.

Sociotropy-Autonomy Scale. The Sociotropy-Autonomy Scale is a commonly used measure for assessing one's level of sociotropy and autonomy (Clark et al., 1995; Clark et al., 1997; Sato, 1999; Sato and McCann, 1997, 1998, 2000). The characteristics and psychometric properties of the scale are discussed in the Method section of Study 1.

RESULTS

Relationship Duration and Satisfaction

The results of the brief survey regarding the duration and satisfaction of their relationships indicated that 6% of the couples were in their present relationship for less than 6 months, 24% of them were in their current relationship for 6-12 months, 33% for 1-2 years, and 37% for more than 2 years. The mean rating for satisfaction regarding their current relationship was 4.6 on a five-point scale, indicating high levels of relationship satisfaction.

Sociotropy-Autonomy Scale

The coefficient alphas for the Sociotropy-Autonomy Scale were .89, for the sociotropy measure, and .72 for the autonomy (solitude) measure. The means and standard deviations for these measures are listed in Table 2. Although these means are slightly lower than the means reported in Study 1, they are nevertheless comparable to the means and standard deviations reported in previous research with similar samples (Clark et al., 1995; Sato, 2003). A set of *t*-tests examining gender differences revealed that females scored significantly higher on sociotropy than males, $t(218) = 5.56, p < .001$. In addition, males scored significantly higher on autonomy (solitude) than females, $t(218) = 4.67, p < .001$.

Table 2. Means, Standard Deviations, and Correlations for Sociotropy-Autonomy and Behavior Ratings

Variable	Mean	SD	1	2	3	4	5	6	7	8
1. Male Sociotropy	53.25	16.99	-	.61**	.39**	.21*	-.06	.15	-.08	.22*
2. Male Autonomy	20.26	6.51	.61**	-	.18	.37**	.11	.08	.03	.10
3. Male HCLA	5.10	1.85	.39**	.18	-	.01	-.10	-.14	.11	-.04
4. Male LCLA	5.68	2.03	.21*	.37**	-.01	-	-.01	.14	-.08	.18
5. Female Sociotropy	64.82	13.72	-.06	.11	-.10	-.01	-	.24*	.38**	.08
6. Female Autonomy	16.32	5.68	.15	.08	-.14	.14	.24*	-	.00	.41**
7. Female HCLA	5.96	1.81	-.08	.03	.11	-.08	.38**	.00	-	-.07
8. Female LCLA	5.41	1.89	.22*	.10	-.04	.18	.08	.41**	-.07	-

* $p < .05$, ** $p < .01$

Note: $N = 110$

Behavior Coding

Two independent raters familiar with the interpersonal circumplex model viewed each interaction session from the beginning to end (full eight minutes). They then coded the videotaped behaviors of the individuals in each romantic partnership according to their levels of control and affiliation on a ten-point scale (1-7). Each of the raters viewed the videotape twice, once for rating the female participant and once for rating the male participant. Ratings were made holistically, assessing the amount of control and affiliation of each person exhibited after watching the complete eight minute segment. The two raters viewed the videotapes separately and were unaware of the sociotropy and autonomy scores of the individuals videotaped. The inter-rater reliability values for the coding of the two behavioral dimensions were very good. The intraclass correlations for control and affiliation were .88 and .89, respectively.

We then used a formula to transform each of the variables so that we have a variable that corresponds to the High Control-Low Affiliation vector of the interpersonal circle. Since the High Control-Low Affiliation vector is at a 45 degree angle between high control and low affiliation we obtained this variable in the following manner. We first reversed the affiliation rating so that higher ratings are lower in affiliation. We then squared both the control and reversed affiliation ratings and added them together. The square root of that sum was considered to be the High Control-Low Affiliation score of the individual. We will refer to this variable as "HCLA" in all subsequent discussions.

We used the same principles to create a formula for the Low Control-Low Affiliation vector of the interpersonal circle. Since the Low Control-Low Affiliation vector is at a 45 degree angle between low control and low affiliation we obtained this variable in the following manner. We first reversed both the affiliation and control rating so that higher ratings are lower in both affiliation and control. We then squared both the reversed control and reversed affiliation ratings and added them together. The square root of that sum was considered to be the Low Control-Low Affiliation score of the individual. We will refer to this variable as "LCLA" in all subsequent discussions. The means and standard deviations for these measures are listed in Table 2. A set of *t*-tests examining gender differences revealed that females scored significantly higher on HCLA than males, $t(218) = 3.50, p < .001$. There was no significant gender difference with LCLA.

Correlations

The results of the correlational analyses are presented in Table 2. As found commonly in previous research (e.g., Clark et al., 1995; Clark and Oates, 1995; Robins et al., 1995; Sato and McCann, 1997; Sato, McCann, and Ferguson-Isaac, 2004), there was a positive correlation between one's own level of sociotropy and one's own level of autonomy among both females and males. As hypothesized, there was also a positive correlation between one's own level of sociotropy and one's own level of HCLA for both males and females. This correlation revealed that the higher one's level of sociotropy, the higher one's levels of HCLA. Similarly, as expected, there was a significant positive correlation between one's own level of autonomy and one's own level of LCLA for both males and females. These correlations suggest that the higher one's level of autonomy, the higher one's level of LCLA. Interestingly,

although this was not hypothesized, sociotropy was also positively correlated with the individual's own level of LCLA for males but not for females.

Hierarchical Regression for Predicting LCLA

In order to examine if autonomy level is related to one's own LCLA levels even after other variables in the interaction are accounted for, we conducted two hierarchical regression analyses. We first tried to predict the females' LCLA by entering three blocks of predictor variables. In the first step, we entered the partner's level of LCLA and HCLA as predictor variables. We then entered the females' level of sociotropy as a predictor variable, and finally we entered the females' level of autonomy as the last predictor variable. The result of this analysis is summarized in Table 3. Even though the first two steps do not make a significant contribution as predictor variables, the female's level of autonomy, the only variable in the third step, contributes significantly to the prediction of the female's level of LCLA after all predictors in the previous two steps have been accounted for, $B = .133$, $SE = .031$, $\beta = .400$, $t(105) = 4.330$, $p < .001$.

We then conducted the same hierarchical regression analysis for males by switching the all variables from male to its female counterpart or from female to its male counterpart. The result of the regression analysis predicting the male's level of LCLA is also summarized in Table 3. Even though the first two steps do not make a significant contribution as predictor variables, male's level of autonomy, the only variable in the third step, contributes significantly to the prediction of the male's level of LCLA after all predictors in the previous two steps have been accounted for, $B = .128$, $SE = .035$, $\beta = .410$, $t(105) = 3.630$, $p < .001$.

Table 3. Hierarchical Regression Analyses Predicting LCLA

	Variable	Model			Coefficients			
		ΔR^2	Df	p	B (SE)	β	t	p
Females N = 110	Step 1	.034	107	.160				
	Partner HCLA				.020 (.091)	.019	.217	.829
	Partner LCLA				.116 (.083)	.124	1.395	.166
	Step 2	.006	106	.435				
	Self Sociotropy				-.002 (.013)	-.016	.181	.857
	Step 3	.146	105	.000				
	Self Autonomy				.133 (.031)	.400	4.330	.000
Males N = 110	Step 1	.036	107	.138				
	Partner HCLA				-.092 (.101)	-.082	.914	.363
	Partner LCLA				.162 (.098)	.151	1.653	.101
	Step 2	.029	106	.071				
	Self Sociotropy				-.010 (.014)	-.081	.698	.487
	Step 3	.104	105	.000				
	Self Autonomy				.128 (.035)	.410	3.630	.000

Hierarchical Regression for Predicting HCLA

In order to examine if sociotropy level is related to one's own HCLA levels even after other variables in the interaction are accounted for, we conducted two additional hierarchical regression analyses. We first tried to predict the females' HCLA by entering three blocks of predictor variables. In the first step, we entered the partner's level of HCLA and LCLA as predictor variables. In the second step, the females' level of autonomy was entered as the predictor variable, and finally we entered the females' level of sociotropy as the last predictor variable. The result of this analysis is summarized in Table 4. Even though neither of the first two blocks make a significant contribution as predictor variables, the female's level of sociotropy, the only variable in the third step, contributes significantly to the prediction of the female's level of HCLA after all predictors in the previous two steps have been accounted for, $B = .054, SE = .012, \beta = .408, t(105) = 4.458, p < .001$.

We then conducted the same analysis for the male participants. The result of this regression analysis is also summarized in Table 4. Even though neither of the first two steps make a significant contribution as predictor variables, male's level of sociotropy, the only variable in the third step, contributes significantly to the prediction of the male's level of HCLA after all predictors in the previous two steps have been accounted for, $B = .056, SE = .012, \beta = .512, t(105) = 4.514, p < .001$.

DISCUSSION

The findings of the present study indicated that 94% of the couples examined were in their present relationship for over 6 months. Moreover, 70% of the couples examined were in their present relationship for over 1 year. In addition, the couples generally reported that they were very satisfied in their present relationships.

Table 4. Hierarchical Regression Analyses Predicting HCLA

		<i>Model</i>			<i>Coefficients</i>			
<i>Variable</i>		ΔR^2	Df	P	B (SE)	β	t	p
Females N = 110	Step 1	.019	107	.365				
	Partner HCLA				.142 (.088)	.145	1.616	.109
	Partner LCLA				-.056 (.080)	-.062	.697	.487
	Step 2	.001	106	.767				
	Self Autonomy				.021 (.030)	.067	.720	.473
	Step 3	.156	105	.000				
	Self Sociotropy				.054 (.012)	.408	4.458	.000
Males N = 110	Step 1	.014	107	.481				
	Partner HCLA				.154 (.090)	.151	1.709	.090
	Partner LCLA				-.122 (.088)	-.125	1.391	.167
	Step 2	.031	106	.065				
	Self Autonomy				-.037 (.032)	-.128	1.156	.250
	Step 3	.155	105	.000				
	Self Sociotropy				.056 (.012)	.512	4.514	.000

The internal consistency and inter-rater reliability values of the measures used to test our hypothesis ranged from being acceptable to very high.

As was hypothesized, the correlation analyses suggested that highly sociotropic individuals display more behaviors that are high in control and low in affiliation than individuals low in sociotropy. The results of the hierarchical regression analyses for both males and females also provided further support for this notion. Since sociotropy was the only significant predictor after entering all variables associated with the partner's behaviors as well as one's own level of autonomy, we can state with a considerable amount of confidence that high sociotropy may indeed be associated with behaviors that are high in control and low in affiliation.

Furthermore, as expected, the results of the correlation analyses suggested that highly autonomous individuals display more behaviors that are low in control and low in affiliation than individuals low in autonomy. The results of the hierarchical regression analyses for both males and females also provided further support for this notion. Since autonomy was the only significant predictor after entering all variables associated with the partner's behaviors as well as one's own level of sociotropy, we can state with a considerable amount of confidence that high autonomy may indeed be associated with behaviors that are low in control and low in affiliation. All of the findings regarding the correlation and hierarchical regression analyses discussed above are not only consistent with our hypotheses, but are also comparable to the results of Study 1.

The findings of Study 2 demonstrate that individuals high in sociotropy not only expect themselves to act in a manner that can be characterized as high in control and low in affiliation toward close people in their lives, but do, in fact, demonstrate such behaviors (high HCLA) during interactions with their romantic partners. In addition, the findings of Study 2 indicate that highly autonomous individuals not only expect themselves to behave in a manner characterized as low in control and low in affiliation towards those close to them, but actually display such characteristics (high LCLA) during interpersonal exchanges with their romantic partners.

The results also revealed a positive correlation between sociotropy and autonomy. This result indicates that those individuals who are highly sociotropic are also likely to be highly autonomous, and *visa versa*. Although there has been little attempt to explain these types of correlations in the past, this finding is not uncommon (Clark et al., 1995; Clark and Oates, 1995; Robins et al., 1995; Sato and McCann, 1997). This correlation may be caused by the common variance that these two variables share with depression (Sato and McCann, 2000; Sato, McCann, and Ferguson-Isaac, 2004). Although sociotropy and autonomy seem like opposing ends of one personality dimension, there are many individuals who are high in both sociotropy and autonomy (McCann and Sato, 2006). These individuals are most commonly considered to be the most vulnerable to depression (Robins, 1995). In the current study, we found that this correlation is especially high among males ($r = .61$). This high correlation among males may have also contributed to the unexpected but significant correlation between sociotropy and LCLA among males. Although we can only speculate at this point, perhaps this correlation was also caused by the common variance that these two variables share with depression.

GENERAL DISCUSSION

The purpose of Study 1 was to examine the interpersonal tendencies of sociotropic and autonomous individuals in social interactions using self-report questionnaires. In particular, this study focused on the interpersonal problems these individuals tend to experience when interacting with specific people close to them. It was found that those who are highly sociotropic tend to behave in ways that are characterized as being intrusive, vindictive, domineering, and cold in these types of relationships. On the other hand, it was discovered that individuals high in autonomy tend to display behaviors characterized as being cold, socially avoidant, and nonassertive when interacting with people close to them.

The goal of Study 2 was to move beyond the method of self-report questionnaires and to actually observe the interpersonal behaviors of individuals with varying levels of sociotropy and autonomy. In order to examine this, we coded the behaviors of individuals with varying levels of sociotropy and autonomy while they engaged in a conflict resolution task with their romantic partners. The findings of this study suggested that highly sociotropic individuals display more behaviors characterized as High Control-Low Affiliation than individuals low in sociotropy. The results also suggested that highly autonomous individuals display more behaviors characterized as Low Control-Low Affiliation than individuals low in autonomy. If we examine these behavioral tendencies in relation to the Interpersonal Circumplex Model, these findings seem to be consistent with the results of Study 1. The characteristics of being too intrusive, too vindictive, too domineering, and too cold, associated with highly sociotropic individuals in Study 1, roughly correspond to the section characterized as High Control-Low Affiliation (top-left) of the interpersonal circle (see Figure 2). In addition, the behaviors that highly autonomous individuals reported in Study 1 of being too cold, socially avoidant, and too nonassertive roughly correspond to the section characterized as Low Control-Low Affiliation (bottom-left) of the interpersonal circle (see Figure 2).

These findings of Study 2 demonstrate that individuals high in sociotropy not only expect themselves to act in a manner described as High Control-Low Affiliation toward close people in their lives, but do, in fact, demonstrate such behaviors during interactions with their romantic partners. In addition, the findings of Study 2 indicate that highly autonomous individuals not only expect themselves to behave in a way manner described as Low Control-Low Affiliation towards those close to them, but actively display such characteristics during interpersonal exchanges with their romantic partners.

The results of the present research project, to some extent, overlap with the findings of other research regarding the interpersonal tendencies of sociotropic and autonomous individuals in close relationships (e.g., Alden and Bieling, 1996; Lynch et al., 2001; Sato, 1999; Sato et al., 2002; Sato and McCann, 2007). It suggests that highly sociotropic individuals behave in a manner considered to be high in control and low in affiliation whereas highly autonomous individuals act in a manner characterized as low in both control and affiliation toward those close to them. One possible explanation for this finding regarding sociotropic individuals is that because these individuals have a strong need for nurturance and intimacy, they are more motivated and active in their interactions when they need to resolve conflict with important others (see Lynch et al., 2001). This interpretation may particularly apply to the findings of Study 2 since we observed the behaviors of the participants while they engaged in a conflict resolution task. Because interpersonal conflict prevents sociotropic

individuals from satisfying their need for nurturance and intimacy, they may be more likely to make an active attempt to resolve the conflict. This active attempt may result in behaviors that are considered to be high in control. However, since they are likely to be defensive while they are discussing a topic that is a source of conflict between themselves and their partner, their behaviors may be low in affiliation. Ironically perhaps, these behaviors may contribute to even more stress in the highly sociotropic person's social environment.

On the other hand, highly autonomous individuals were found to behave in ways that are low in both control and affiliation in these relationships. Although we did not examine how the romantic partners of the autonomous individuals behaved in relation to them, Lynch and his colleagues have found that while autonomous individuals reported themselves as being withdrawing, they rated their romantic partners as being demanding (Lynch et al., 2001). These researchers suggested that this behavior on the part of the autonomous individuals may be a reaction to the demanding behavior of their partners (Lynch et al., 2001). In the literature on marital couples, the demand-withdraw pattern has been discussed extensively as a common interaction pattern (Rusbult and Van Lange, 2003). To some extent, this pattern is also consistent with the Interpersonal Circumplex Model. When our partner is demanding, which is often regarded as high-control behavior, we tend to react by behaving in a manner characterized at least partially as low-control (withdrawal is often considered to be a combination of low-control and low-affiliation). This reaction would be partially consistent with the Interpersonal Circumplex Model because behavior that is low in control is considered to be complementary to behavior that is high in control (Kiesler, 1992, 1996; Leary, 1957; Orford, 1986, 1994; Sato and McCann, 2007). In addition to this, it may be reasonable to assume that these withdrawing behaviors of highly autonomous individuals may increase their levels of stress in the long run. Despite the fact that we can only speculate regarding the reasons why sociotropic and autonomous individuals have these interaction tendencies, the findings of the present study seem to be consistent with the work of Hammen (1991, 1992) and Shih (2006) suggesting that individuals with personalities that make them vulnerable to depression have a tendency to make their environments more stressful than other individuals.

Due to various limitations of the present research project, many key questions regarding the interpersonal characteristics of sociotropic and autonomous individuals still remain unanswered. For instance, various interpersonal researchers have suggested that the responses of people we commonly interact with help shape and maintain these interpersonal patterns (e.g., Coyne, 1976; Kiesler, 1996; Luborsky, 1984; Strupp and Binder, 1984). In order to develop a better understanding of the divergent interpersonal patterns associated with sociotropy and autonomy, future research examining the reactions of important others in these interpersonal interactions may be necessary. Furthermore, this line of research does suggest that the person we are interacting with does make a difference in how we behave (see Sato and McCann, 2007). In Study 1, we examined the interaction tendencies of individuals in a wide range of relationship contexts such as relationships with romantic partners, mothers, siblings, or best friends. Study 2 was focused solely on interactions with romantic partners. In the future, it may be useful to compare and contrast interactions with different types of people such as parents, siblings, romantic partners, best friends, and strangers in order to examine the generalizability and specificity of these interaction patterns.

Finally, even though Lynch and his colleagues found partially overlapping results with a clinical sample using self-report methods (Lynch et al., 2001), the generalizability of the

present research project is limited due to the fact that our sample was from a non-clinical population. Although examining non-depressed individuals is critical in developing a better understanding of individuals who are currently not depressed but vulnerable to depression, future work involving direct observations of the interpersonal behaviors of sociotropic and autonomous individuals with clinical levels of depression would undoubtedly add significantly to understanding the nature of these vulnerabilities. The findings of these future studies may have important implications concerning not only the nature of these personality characteristics, but also the treatment and prevention methods of these two subtypes of depression.

In conclusion, the findings of the present research provide further support for the notion that although various researchers have investigated interpersonal factors regarding the etiology and maintenance of depression in general (e.g., Biglan, et al., 1985; Blumberg and Hokanson, 1983; Coyne, 1976; Joiner and Coyne, 1999; Joiner and Metalsky, 1995; Kahn, Coyne, and Margolin, 1985), it may be necessary to consider these interpersonal factors separately for sociotropic and autonomous subtypes of depression (e.g., Alden and Bieling, 1996; Lynch et al., 2001; Sato and McCann, 2001). The present research project focusing on the interpersonal behavior patterns of individuals with varying levels of sociotropy and autonomy seems to provide some important preliminary insights regarding this matter. We hope that the present research project will serve as another step to developing a more complete interpersonal model of depression in the near future.

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REFERENCES

- Alden, L. E., and Bieling, P. J. (1996). Interpersonal convergence of personality constructs in dynamic and cognitive models of depression. *Journal of Research of Personality*, 30,60-75.
- Alden, L. E., Wiggins, J. S., and Pincus, A. L. (1990). Construction of circumplex scales for the Inventory of Interpersonal Problems. *Journal of Personality Assessment*, 55, 537-548.
- Beck, A. T. (1967). *Depression: Clinical, experimental, and theoretical aspects*. New York: Hoeber.
- Beck, A. T. (1976). *Cognitive therapy and the emotional disorders*. New York: International Universities Press.
- Beck, A. T. (1983). Cognitive therapy of depression: New perspectives. In P. J. Clayton and J. E. Barrett (Eds.) *Treatment of depression: Old controversies and new approaches*, (pp. 265-290).New York: Raven Press.
- Beck, A. T. (1987). Cognitive models of depression. *Journal of Cognitive Psychotherapy, An International Quarterly*, 1, 5-37.

- Beck, A. T., Epstein, N., and Harrison, R. (1983a). Cognitions, attitudes and personality dimensions in depression. *British Journal of Cognitive Psychotherapy*, *1*, 1-16.
- Beck, A. T., Epstein, N., Harrison, R. P., and Emery, G. (1983b). *Development of the Sociotropy-Autonomy Scale: A measure of personality factors in psychopathology*. Unpublished manuscript, University of Pennsylvania.
- Beck, A. T., Rush, A. J., Shaw, B. F., and Emery, G. (1979). *Cognitive therapy of depression*. New York: Guilford Press.
- Bieling, P. J., and Alden, L. E. (1998). Cognitive-interpersonal patterns in dysphoria: The impact of sociotropy and autonomy. *Cognitive Therapy and Research*, *22*, 161-178.
- Bieling, P. J., and Alden, L. E. (2001). Sociotropy, autonomy, and the interpersonal model of depression: An integration. *Cognitive Therapy and Research*, *25*, 167-184.
- Bieling, P. J., Beck, A. T., and Brown, G. K. (2000). The Sociotropy-Autonomy Scale: Structure and implications. *Cognitive Therapy and Research*, *24*, 763-780.
- Biglan, A., Hops, H., Sherman, L., Friedman, L. S., Arthur, J., and Osteen, V. (1985). Problem-solving interactions of depressed women and their husbands. *Behavior Therapy*, *16*, 431-451.
- Blumberg, S. R., and Hokanson, J. E. (1983). The effects of another person's response style on interpersonal behavior in depression. *Journal of Abnormal Psychology*, *92*, 196-209.
- Carson, R. C. (1979). Personality and exchange in developing relationships. In R. L. Burgess and T. L. Huston (Eds.), *Social exchange in developing relationships* (pp. 247-269). New York: Academic Press.
- Carson, R. C. (1982). Self-fulfilling prophecy, maladaptive behavior, and psychotherapy. In J. C. Anchin and D. J. Kiesler (Eds.), *Handbook of interpersonal psychotherapy* (pp. 64-77). Elmsford, NY: Pergamon.
- Clark, D. A., Beck, A. T., and Brown, G. K. (1992). Sociotropy, Autonomy, and life event perceptions in dysphoric and nondysphoric individuals. *Cognitive Therapy and Research*, *16*, 635-652.
- Clark, D. A., and Oates, T. (1995). Daily hassles, major and minor life events, and their interaction with sociotropy and autonomy. *Behaviour Research and Therapy*, *33*, 819-823.
- Clark, D. A., Steer, R. A., Beck, A. T., and Ross, L. (1995). Psychometric characteristics of revised sociotropy and autonomy scales in college students. *Behaviour Research and Therapy*, *33*, 325-334.
- Clark, D. A., and Steer, R. A. (1996). Empirical status of the cognitive model of anxiety and depression. In P. M. Salkovskis (Ed.), *Frontiers in cognitive therapy* (pp. 75-96). New York: Guilford Press.
- Clark, D. A., Steer, R. A., Haslam, N., Beck, A. T., and Brown, G. K. (1997). Personality vulnerability, psychiatric diagnoses, and symptoms: Cluster analyses of sociotropy autonomy subscales. *Cognitive Therapy and Research*, *21*, 267-283.
- Coyne, J. C. (1976). Toward and interactional description of depression. *Psychiatry*, *39*, 28-40.
- Coyne, J. C., and Whiffen, V. E. (1995). Issues in personality as diathesis for depression: The case of sociotropy-dependency and autonomy-self-criticism. *Psychological Bulletin*, *118*, 358-378.

- Hammen, C. (1991). The generation of stress in the course of unipolar depression. *Journal of Abnormal Psychology, 100*, 555-561.
- Hammen, C. (1992). Cognitive, life stress, and interpersonal approaches to a developmental psychopathology model of depression. *Development and Psychopathology, 41*, 189-206.
- Hammen, C., Ellicott, A., and Gitlin, M. (1989). Vulnerability to specific life events and prediction of course of disorder in unipolar depressed patients. *Canadian Journal of Behavioural Science, 21*, 377-388.
- Hammen, C., Ellicott, A., and Gitlin, M. (1992). Stressors and sociotropy/autonomy: A longitudinal study of their relationship to the course of bipolar disorder. *Cognitive Therapy and Research, 16*, 409-418.
- Hammen, C., Ellicott, A., Gitlin, M., and Jamieson, K. R. (1989) Sociotropy/autonomy and vulnerability to specific life events in patients with unipolar depression and bipolar disorders. *Journal of Abnormal Psychology, 98*, 154-160.
- Hankin, B. L., and Abramson, L. Y. (2001). Development of gender differences in depression: An elaborated cognitive vulnerability transactional stress theory. *Psychological Bulletin, 127*, 773-796.
- Hill, C., and Safran, J. D. (1994). Assessing interpersonal schemas: Anticipated responses of significant others. *Journal of Social and Clinical Psychology, 13*, 366-379.
- Joiner, T. E., Alfano, M. S., and Metalsky, G. I. (1992). When depression breeds contempt: Reassurance seeking, self-esteem, and rejection of depressed college students by their roommates. *Journal of Abnormal Psychology, 69*, 778-788.
- Joiner, T. E., and Coyne, J. C. (1999). *The interactional nature of depression: Advances in interpersonal approaches*. Washington, DC: American Psychological Association.
- Joiner, T. E., and Metalsky, G. I. (1995). A prospective study of an integrative interpersonal theory of depression: A naturalistic study of college roommates. *Journal of Personality and Social Psychology, 69*, 778-788.
- Kahn, J., Coyne, J. C., and Margolin, G. (1985). Depression and marital disagreement: The social construction of despair. *Journal of Social and Personal Relationships, 2*, 447-461.
- Kiesler, D. J. (1982). Interpersonal theory for personality and psychotherapy. In J. C. Anchin and D. J. Kiesler (Eds.), *Handbook of interpersonal psychotherapy* (pp. 3-24). Elmsford, NY: Pergamon.
- Kiesler, D. J. (1983). The 1982 Interpersonal circle: A taxonomy for complementarity in human transactions. *Psychological Review, 90*, 185-214.
- Kiesler, D. J. (1992). Interpersonal circle inventories: Pantheoretical applications to psychotherapy research and practice. *Journal of Psychotherapy Integration, 2*, 77-99.
- Kiesler, D. J. (1996). *Contemporary interpersonal theory and research*. New York: Wiley.
- Kwon, P. and Whisman, M. A. (1998). Sociotropy and autonomy as vulnerabilities to specific life events: Issues in life event categorization. *Cognitive Therapy and Research, 22*, 353-362.
- LaPiere, R. T. (1934). Attitudes versus actions. *Social Forces, 13*, 230-237.
- Leary, T. F. (1955). The theory and measurement methodology of interpersonal communication. *Psychiatry, 18*, 147-161.
- Leary, T. F. (1957). *Interpersonal diagnosis of personality*. New York: Ronald.

- Libet, J. M., and Lewinsohn, P. M. (1973). Concept of social skill with special reference to the behavior of depressed persons. *Journal of Consulting and Clinical Psychology, 40*, 304-312.
- Luborsky, L. (1984). *Principles of psychoanalytic psychotherapy: A manual for Supportive-Expressive Treatment*. New York: Basic Books.
- Lynch, T. R., Robins, C. J., and Morse, J. Q. (2001). Couple functioning in depression: The roles of sociotropy and autonomy. *Journal of Clinical Psychology, 57*, 93-103.
- McCann, C. D. (1990a). The self and interpersonal relations. In J. M. Olson, and M. P. Zanna (Eds.), *Self-inference processes: The Ontario symposium* (vol. 6, pp.191-215). Hillsdale, NJ: Erlbaum.
- McCann, C. D. (1990b). Social factors in depression: The role of interpersonal expectancies. In C. D. McCann, and N. S. Endler (Eds.), *Depression: New directions in theory, research, and practice*, (pp. 27-47). Toronto: Wall and Emerson.
- McCann, C. D., and Endler, N. S. (Eds.). (1990). *Depression: New directions in theory, research, and practice*. Toronto: Wall and Emerson.
- McCann, C. D., and Lalonde, R. N. (1993). Dysfunctional communication and depression: Social cognitive processes. *American Behavioral Scientist, 36*, 271-287.
- McCann, D., and Sato, T. (2007). *Individuality and interrelationship: The nature of self-construal in sociotropy and autonomy*. Manuscript under review for *The Journal of Social and Clinical Psychology*.
- McCann, D., and Segrin, C. (1996). Communication and psychopathology: An overview. *Communication Research, 23*, 370-378.
- Mongrain, M., Vetteese, L. C., Shuster, B., and Kendal, N. (1998). Perceptual biases, affect, and behavior in the relationships of dependents and self-critics. *Journal of Personality and Social Psychology, 75*, 230-241.
- Murphy, B., and Bates, G. W. (1997). Adult attachment style and vulnerability to depression. *Personality and Individual Differences, 22*, 835-844.
- Nietzel, M. T., and Harris, M. J. (1990). Relationship of dependency and achievement/autonomy to depression. *Clinical Psychology Review, 10*, 279-297.
- Orford, J. (1986). The rules of interpersonal complementarity: Does hostility beget hostility and dominance, submission? *Psychological Review, 93*, 365-377.
- Orford, J. (1994). The interpersonal circumplex: A theory and method for applied psychology. *Human Relations, 46*, 1347-1375.
- Robins, C. J. (1995). Personality-event interaction models of depression. *European Journal of Personality, 9*, 367-378.
- Robins, C. J., and Block, P. (1988). Personal vulnerability, life events, and depressive symptoms: A test of a specific interaction model. *Journal of Personality and Social Psychology, 54*, 847-852.
- Robins, C. J., Hayes, A. M., Block, P., Kramer, R. J., and Villena, M. (1995). Interpersonal and achievement concerns and the depressive vulnerability and symptom specificity hypotheses: A prospective study. *Cognitive Therapy and Research, 19*, 1-20.
- Rusbult, C. E. and Van Lange, P. A. M. (2003). Interdependence, Interaction, and Relationships. *Annual Review of Psychology, 54*, 351-374.
- Sato, T. (1999). *Sociotropy-Autonomy and Interpersonal Schemas: An Interpersonal Model Predicting Affect*. Unpublished Doctoral Dissertation, York University, Toronto, Canada.

- Sato, T. (2003). Sociotropy and autonomy: The nature of vulnerability. *The Journal of Psychology, 137*, 447-466.
- Sato, T., Groomett, C. M., Lyons, M. E., Scott, V. L., and Torquato, T. (2002, March). *Sociotropy-autonomy and interpersonal problems with close others*. Paper presented at the 2002 annual convention of the Southeastern Psychological Association, Orlando, Florida, USA.
- Sato, T., and McCann, D. (1997). Vulnerability factors in depression: The facets of Sociotropy and Autonomy. *Journal of Psychopathology and Behavioral Assessment, 19*, 41-62.
- Sato, T., and McCann, D. (1998). Individual differences in relatedness and individuality: An exploration of two constructs. *Personality and Individual Differences, 24*, 847-859.
- Sato, T., and McCann, D. (2000). Sociotropy-Autonomy and the Beck Depression Inventory. *European Journal of Psychological Assessment, 16*, 66-76.
- Sato, T., and McCann, D. (2001, April). *Sociotropy-autonomy and interpersonal problems*. Paper presented at the 2001 annual convention of the Eastern Psychological Association, Washington, D.C., USA.
- Sato, T., and McCann, D. (2002). Advances in the study of sociotropy-autonomy and depression. In S. P. Shohov, (Ed.), *Advances in Psychological Research* (vol. 17, pp. 35-53). Hauppauge, New York: Nova Science.
- Sato, T. and McCann, D. (2007). Sociotropy-autonomy and interpersonal problems. *Depression and Anxiety, 24*, 153-162.
- Sato, T., McCann, D., and Ferguson-Isaac, C. (2004). Sociotropy and autonomy and situation specific anxiety. *Psychological Reports, 94*, 67-76.
- Shih, J. H. (2006). Sex differences in stress generation: An examination of sociotropy/autonomy, stress, and depressive symptoms. *Personality and Social Psychology Bulletin, 32*, 434-446.
- Strupp, H. H., and Binder, J. L. (1984). *Psychotherapy in a new key: A guide to Time-Limited Dynamic Psychotherapy*. New York: Basic Books.
- Sullivan, H. S. (1953). *The interpersonal theory of psychiatry*. New York: Norton
- Wicker, A. W. (1969). Attitudes versus actions: The relationship of verbal and overt responses to attitude objects. *Journal of Social Issues, 25*, 41-78.
- Wiggins, J. S. (1995). *Interpersonal adjective scales: Professional manual*. Odessa, FL: Psychological Assessment Resource.
- Wiggins, J. S., and Broughton, R. (1985). The interpersonal circle: A structural model for the integration of personality research. In R. Hogan and W. H. Jones (Eds.), *Perspectives in personality: A research annual* (vol. 1, pp. 1-47). Greenwich, CT: JAI Press.
- Youngren, M. A., and Lewinsohn, P. M. (1980). The functional relationship between depression and problematic interpersonal behavior. *Journal of Abnormal Psychology, 89*, 331-341.
- Zuroff, D. C., and Duncan, N. (1999). Self-criticism and conflict resolution in romantic couples. *Canadian Journal of Behavioural Science, 31*, 137-149.
- Zuroff, D. C., and Fitzpatrick, D. K. (1995). Depressive personality styles: Implications for adult attachment. *Personality and Individual Differences, 18*, 253-265.
- Zuroff, D. C., Mongrain, M., and Santor, D. A. (2004). Conceptualizing and measuring personality vulnerability to depression: Comment on Coyne and Whiffen (1995). *Psychological Bulletin, 130*, 489-511.

Zuroff, D. C., Santor, D. A., and Mongrain, M. (2005). Dependency, self-criticism, and maladjustment. In J. S. Auerbach, K. J. Levy, and C. E. Schaffer (Eds.), *Relatedness, self-definition and mental representation: Essays in honor of Sidney J. Blatt* (pp. 75-90). New York: Routledge.

Chapter 15

CHILDREN'S UNDERSTANDING OF SOCIAL ACTS AND SOCIAL INTERACTIONS

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ABSTRACT

This paper explores the development of a conception of social interactions as contingent exchanges in which social partners participate in bidirectional influence. Research on children's understanding of the causes and consequences of social acts, children's ability to consider contrasting perspectives on the same social event, and children's second-order mental state reasoning is reviewed. These concepts and abilities may provide a foundation for a transition from understanding social acts to understanding social interaction. Possible developmental patterns are discussed and directions for research are identified.

From infancy onward, children engage in social acts and participate in increasingly complex and subtle forms of social interaction. Learning to understand their social experiences helps children to negotiate their social worlds. Although many social exchanges occur spontaneously, without conscious deliberation, prior planning, or subsequent analysis, in some circumstances reflecting on social experience facilitates adaptive social behavior and appropriate regulation of emotional responses. As adults, we possess rich knowledge about our own social behavior and that of others. Adults recognize their own typical patterns of behavior, thoughts, and affective responses in particular social situations or relationships, and adults have similar beliefs about others' behavior and mental states. Adults also have beliefs about the causes and consequences of social actions, knowledge of strategies for achieving social goals and solving social problems, and knowledge of norms for behavior in various

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social contexts. Despite the large research literatures on both childhood and adult social cognition, research that directly addresses children's understanding of social interaction is limited. Therefore, the goals of this chapter are to speculate about the development of children's understanding of social interactions and to identify directions for future investigation. I begin with a rough sketch of a mature folk conception of social interaction. Then I consider possible developmental steps toward such a mature understanding and discuss factors that may contribute to developmental progress.

CONCEPTUALIZING SOCIAL INTERACTION

Social interactions are distinct from social acts and social relationships (Moore, 2006; Rubin, Bukowski, and Parker, 1998). Social acts include responses to other people and actions that are directed toward, or influence, another person or group. Social interactions are exchanges of a sequence of contingent social acts that are characterized by mutual influence. Social relationships involve a succession of social interactions between individuals who know each other, have a history of past interactions, and expect to engage in future interactions. These distinctions are important for describing a folk conception of social interaction and its development. Because social acts are a component of social interactions, learning about social acts could be a basic building block for knowledge of social interactions. Furthermore, because social interactions often occur within social relationships, understanding how social relationships influence interactions could be part of an advanced understanding of social interaction. Thus, these distinctions are useful for defining different aspects of social cognition. Children may have some understanding of social acts without necessarily understanding social interaction, and children may have some understanding of social interaction before they fully recognize the impact of social relationships on social acts and interactions.

Recognition of bidirectional influence is at the core of a mature concept of social interaction. An interaction is more than a sequence of discrete, independent social acts. Within a social interaction, each participant influences, and is influenced by, the other person's actions. Bidirectional influence occurs at the level of actions, thoughts, intentions, and emotions. A mature concept of social interaction also would include recognition of indirect effects. Some forms indirect influence are implied by the occurrence of bidirectional influence. For example, evocative effects are bidirectional and indirect. Person A's actions influence Person B's actions and mental states, which in turn influence Person A. Thus, Person A's actions elicit social experiences that affect Person A. Other types of indirect effects occur when multiple participants interact with each other. Person A's actions may influence Person B's response to Person C, so that A indirectly affects C. Because the concepts of bidirectional influence and indirect influence are central to understanding the patterns of causality that distinguish social interactions from individual social acts, these concepts are core features of a concept of social interaction. In addition to these two core features, an advanced understanding of social interaction could include (a) knowledge of specific patterns of interaction, (b) recognition that participants may have different perspectives on the same interaction, (c) understanding that interactions may be comprised of both intentional and unintentional actions, (d) recognition of contextual influences on social

interactions, such as social relationships, social roles, group norms, and cultural norms, and (e) moral evaluation of social interactions. Adults may vary greatly in the extent of their understanding of social interactions and in the readiness with which they apply such knowledge to their social experiences. Indeed, research on adults' causal attributions and understanding of emotions in close relationships indicates there are important individual differences in social cognition (e.g., Gottman, Katz, and Hooven, 1996; Fincham, Harold, and Gano-Phillips, 2000).

The development of children's understanding of social interaction has not been investigated extensively. Given the subtlety and complexity of concepts of bidirectionality and indirect influence, understanding of social interactions as sequences of contingent actions with mutual influence is likely to emerge in late adolescence or adulthood, rather than during childhood. Even in adulthood, a full grasp of the nature of social interaction may be less than universal. Nevertheless, the development of concepts that provide a foundation for a mature understanding of social interaction can be examined.

UNDERSTANDING SOCIAL ACTS

Understanding individual social acts includes (a) differentiating among social acts according to their meaning or social function, (b) reasoning about the causes of social acts, and (c) understanding the consequences of social acts for actor, the recipient of the social act, and observers. Research on social cognition, both in children and adults, often has examined reasoning about the causes of actions. Thus, research on children's theory of mind has investigated children's tendency to predict and explain behavior in terms of mental states such as beliefs, desires, emotions, intentions, and goals (see Harris 2006 for a review). Attributional research traditionally investigates the extent to which individuals attribute behavior to internal dispositions versus external situations (see Fiske and Taylor, 2007 for a review). Folk-conceptual theory examines individuals' explanations of behavior in terms of causes, reasons, or the causal history of reasons (see Malle, Knobe, and Nelson, 2007 for a review). In this framework, causes are mechanical forces or events that used to explain unintentional acts. Intentional acts usually are explained by reasons. Reasons refer to an agent's desires, goals, or motives. The causal history of reasons consists of factors that led to an agents's reasons for acting, including the immediate context, personality traits, family background, or culture. As these three approaches illustrate, adults and children may explain actions in a variety of ways. Two central developmental questions are (a) how does the content of children's explanations of actions change with age?, and (b) how does the structure of children's explanations change? There may be age-related changes both in the explanatory constructs children favor in their accounts of social acts and in the complexity of the causal relations children conceive.

A simple causal relation consists of a link between a cause and an effect. Knowledge of simple causal relations could constitute an initial understanding of social acts. For example, children might understand a desire as motivating an action (e.g., a desire to play motivates a child to approach another child and say "hello"), or an action as leading to an outcome (e.g., offering a toy to another child results in shared play). Further advances could take the form of knowledge about a greater variety of causes and effects, or understanding of more complex

causal pathways. That is, older children may distinguish among a greater variety of social acts and a greater of mental states. Making finer distinctions would children to identify more precise relations between mental states and social acts. In addition, older children may conceive of social acts as resulting from multiple causes or as being part of a causal chain with multiple steps.

UNDERSTANDING MENTAL STATES AS CAUSES OF ACTION

Recognition of a link between mental states and actions becomes apparent early in childhood. In their every day conversations, children begin referring to desires and emotions as early as two years of age (e.g., Bartsch and Wellman, 1995). Two-year-olds frequently mention desires and appeal to desires to predict and explain behavior. Three- and 4-year-olds recognize that people act in accordance with their knowledge and beliefs (Bartsch and Wellman, 1989), though initially children find it easier to reason about the relation between true beliefs and action than to reason about false beliefs and action (Wellman and Bartsch, 1988, but see Bartsch, Campbell, and Troseth, 2006 for evidence that young children sometimes refer to false beliefs to explain action). As four- to five year-old children begin to represent both false and true beliefs consistently, more sophisticated reasoning about the causes of actions emerges (Perner, 1991; Wellman, 1990). Thus, Wellman (1990) characterized 3- and 4-year-olds as understanding action in terms of an intuitive belief-desire psychology. Young children also have some understanding of intentions as causing action. By 3 years of age, children distinguish between intended outcomes and unintended outcomes (Shultz and Wells, 1985), and by 4 years of age most children distinguish intentions from both desires and outcomes (Feinfield, Lee, Flavell, Green, and Flavell, 1999).

Much of the research on children's understanding of mental states has examined explanations or predictions of non-social actions, such as search for a hidden object. There may be both similarities and differences in children's understanding of social and non-social actions. On the one hand, both social and non-social actions may be motivated by desires, beliefs, emotions, and intentions. Thus, understanding of the basic casual links between mental states and action can be applied to acts of either sort. In fact, young children perform similarly on tasks requiring them to reason about differences in belief whether the beliefs in question are social in nature (e.g., beliefs about ownership or about the morality of an action) or non-social (e.g., beliefs about the location or attributes of hidden objects), and also perform similarly on judgments about the physical appearance versus reality of objects and apparent versus real social attributes of people (Flavell, 1993). On the other hand, social acts may be motivated by a variety of complex and subtle desires, beliefs, emotions, and goals. Social acts also may result in diverse consequences, and those consequences are typically social and psychological, rather than mechanical. Therefore, the specific content of the mental states that motivate or result from social acts may differ from the content of the mental states involved in non-social acts. As children participate in an increased range of social interactions, they may learn about particular desires, beliefs, intentions, goals, and emotions that are not usually encountered in the course of non-social activities. Consequently, the basic understanding of action that emerges in early childhood may be the same for both social and non-social acts, but the details of children's reasoning about social and non-social acts may diverge as

children's knowledge of social acts and the mental states associated with them grows more differentiated at later ages.

From middle childhood through adolescence knowledge of social acts and social motives increases greatly. In general, when asked to explain social acts, adolescents mention social goals more than do elementary school children, and adolescents and adults mention psychological goals much more often than do children (Pillow, Lovett, and Hill, 2008). For example, compared to elementary school children, adolescents were more likely to say that a story character shared his lunch with another because he wanted to be friends (a social goal) or that a story character declined an invitation because she wanted to make another character feel bad (a psychological goal). Furthermore, understanding of some specific motives for social acts begins to appear during middle childhood and becomes common by late childhood. Thus, recognition of altruism and displaced aggression as motives for interpersonal actions becomes increasingly common (Berndt and Berndt, 1975; Miller and DeMarie-Dreblow, 1990). Older children also evidence greater awareness of self-presentational motives. Between 6- and 8-years of age, children increasingly explain emotion-masking statements as attempts to influence how others evaluate the self (Banerjee and Yuill, 1999). Explanations of self-promotion, ingratiation, and showing off as attempts to manipulate others impression increase in frequency between 8- and 11-years of age (Bennett and Yeeles, 1990, 2001). For example, when asked to generate instances of showing off and then explain them, 8-year-olds were more likely to give intrapersonal explanations, such as "she's really proud of herself", than interpersonal explanations, such as "so Amanda would think that Kate is good at sports and would choose her for the team", but 11-year-olds gave more interpersonal explanations (Bennett and Yeeles, 2001).

In addition to recognizing the motives behind self-presentational behavior, during middle and late childhood, children also begin to appreciate how such behavior influences an audience's appraisal. When asked to evaluate hypothetical modest and immodest responses to praise, 8- to 10-year-old children expect others to view modest behavior more positively than immodest behavior (Banerjee, 2000; Watling and Banerjee, 2007). Children also realize that different audiences may evaluate behavior differently. Accordingly, older children and adolescents view different impression management behaviors as appropriate for different audiences. For example, Juvonen and Murdock (1995) found that fourth-graders were aware of impression management as a motive for social behavior, but eighth-graders regarded different strategies as appropriate for peers versus adults. Watling and Banerjee (2007) reported differentiation between appropriate self-presentation strategies for peer and adult audiences. Children ages 8- to 11-years judged modesty more positively than immodesty, and children judged modesty more positively for peer audiences than for adult audiences. Older children also judged that modesty would result in more positive evaluations by the audience and more positive social outcomes.

These studies of children's understanding of self-presentation indicate that from middle to late childhood children increasingly understand social acts as motivated by social and psychological goals and recognize specific interpersonal motives for particular kinds of social acts. Although studies of children's explanations for social acts have not examined explanations for contingent exchanges of action or investigated recognition of bidirectional influence, older children's awareness of self-presentational motives implies some understanding that social acts (a) are attempts to influence others and (b) are influenced by others' real or assumed views and actions. Furthermore, in addition to recognizing the goals

motivating attempts at impression management, children also reason about an audience's response to these behaviors. Taken together, these studies indicate that 8- to 11-year-old children represent both an actor's intentions toward an audience's mental state, and an audience's evaluation of and response to the actor's behavior. Thus, children's knowledge of self-presentation may mark a transition towards recognizing social acts as situated in interactive social contexts. A full understanding of bidirectional social influence would include understanding both (a) that an actor's behavior may influence an audience's response to the actor, and (b) that the audience's response may then influence the actor's mental states and subsequent social acts. Studies of self-presentational motives have examined children's understanding of the first half of such cycles of interaction, but children's understanding of the full cycle apparently has not yet been investigated.

UNDERSTANDING PERSONALITY TRAITS AS CAUSES OF SOCIAL ACTS

Although actors' momentary mental states often are perceived as the reason for social acts, personality traits also are frequently invoked as explanations for interpersonal behavior. Transient mental states and enduring traits are closely related. Traits can be conceptualized as dispositions to experience particular thoughts, emotions, desires, and motives in particular situations. Trait understanding involves attributing internal psychological characteristics to oneself or others that are stable across time and situations and play a role in causing overt behaviors (Liu, Gelman, and Wellman, 2007; Rotenberg, 1980; Yuill, 1992). In Malle's folk-conceptual theory personality traits are included as part of the causal history of reasons (Malle et al. 2007). As such, traits may lead an actor to have certain desires and motives in a particular situation, with those momentary states being the reasons for actions.

Research on the development of trait understanding has focused on two main issues: (a) when do children attribute stable patterns of behavior to others?, and (b) when do children understand behavioral stability as caused by underlying psychological characteristics? (see Liu et al., 2007; Yuill, 1992 for reviews). Studies of children's understanding of behavioral stability typically present a character engaging in a trait-relevant behavior, such as sharing or being helpful, and ask children to predict future behavior in a different situation. Children younger than approximately 8-years of age often do not predict consistent behavior in such studies (e.g., Berndt and Heller, 1986; Kalish, 2002; Rholes and Ruble, 1984). However, children ages 4-to-7-years can infer traits such as selfish, nice, mean, or shy from past behaviors and also can predict future behavior when provided with trait labels (Liu et al., 2007). Thus, Liu et al. (2007) argue that young children have difficulty predicting future behavior from past behavior because such predictions require a two-step inferential process. Children must first infer a trait from past behavior and use that trait to infer future behavior. When asked to make one of these inferences at a time, children demonstrate understanding of the relation between traits and behavior.

Studies of children's understanding of traits as internal psychological causes have examined children's use of information about the mental state accompanying an action to predict an actor's future actions or mental states. For example, after being told an actor's motive for a social act (e.g. the actor wanted the other person to be happy (or upset) when the actor sprayed the person with water from a hose), 6- to 10-year-olds predicted that in a

different situation the actor would act in a manner consistent with the actor's previous motive (Heyman and Gelman, 1998). Because participants in social interactions bring with them dispositions toward certain patterns of action, thoughts, and emotions, knowledge of personality traits is important for understanding social interactions. Studies of children's trait concepts typically ask children to infer one story character's traits. However, to comprehend social interactions, often children may need to understand how combinations of multiple participants' traits may influence the course of a social event. Moreover, insight into social interactions may be gained by considering how the social context influences the expression of each participant's underlying traits.

UNDERSTANDING THE SITUATIONAL INFLUENCES ON SOCIAL ACTS

In addition to an actor's personality traits and mental states, social acts also are influenced by situational factors. Situational influences include rules, norms, social conventions, social roles, obligations, potential rewards or punishments, as well as others' expectations, desires, requests, or commands. Young children recognize some situational influences on behavior. Three- to 5-year-olds predict that rewards or parental pressure influence a hypothetical child's choice of activities (e.g. Karniol and Ross, 1979; Miller, 1985). Children also are aware of rules, norms, and social conventions. In their moral judgements, 4- and 5-year-olds begin to distinguish between moral rules and social convention, and children's understanding of this distinction continues to grow more elaborate through the late childhood years (Turiel, 1998).

Five-year-olds also use information about rules to predict behavior. Kalish and Shiverick (2004) provided 5-year-olds, 8-year-olds, and adults with information about rules (e.g., the rule is to share food; the rule is to keep toys in the toy box) or about preferences (e.g., Karen likes to share; Jimmy likes to keep toys in the toy box). Five-year-olds predicted a hypothetical person would act in accordance with rules, but did not consistently predict a person's behavior would be consistent with his or her preferences. Eight-year-olds gave the opposite pattern of responses, predicting that future behavior would be consistent with preferences more often than they predicted behavior would be consistent with rules. Adult predicted that behavior would be consistent with both rules and preferences. Although the majority of the rules and preferences concerned non-social acts, these results indicate that young children regard rules as an important influence on behavior.

A major understanding of norms and rules would include appreciation of their variability across groups and contexts. Young adults recognize that beliefs and practices vary across cultures and understand that the meaning of certain practices is related to cultural beliefs (Shaw and Wainryb, 1999). In contrast, children often judge actions based on beliefs different from their own to be wrong (Wainryb and Ford, 1998). When told about a story character engaging in harmful or unfair acts, such as a teacher giving larger snacks to girls than to boys because the teacher believes girls need more food (an informational belief) or because the teacher believes that it is acceptable to be nicer to girls than to boys (a moral belief), 3- to 7-year-olds often judged the acts negatively, especially when they were based on moral beliefs different from children's own moral beliefs. However, 5- and 7-year-olds judged actions based on informational beliefs different from their own more positively than the same actions

based on moral beliefs different from their own. Thus, at 5- to 7-years of age, children are beginning to take account of differences in beliefs when evaluating behavior.

In some situations, to understand a social interaction the social norms framing and guiding the participants' actions must be recognized. If the participants belong to a different social group than the observer, then the observer may need to consider how the participants' norms differ from the observer's own to fully comprehend some details of the interaction. If the participants themselves belong to different social groups, it may be important to determine how each person's norms influence that person's social acts, definition of the social situation, and interpretation of the interaction. Therefore, to understand situational influences on social interactions, children need to learn that (a) norms and rules influence social acts, (b) norms and rules may differ across cultural or social groups, and (c) the construal of a social situation and the meaning of a social act may depend upon the norms and rules participants assume. Reasoning about norms and rules begins during childhood, but full appreciation cultural variability and its significance may remain challenging for many adults.

REASONING ABOUT MULTIPLE CAUSES

Although some insight into social events can be gained by focusing on a single cause, consideration of multiple causal factors may provide a more complete, or even qualitatively different, account. Current mental states, past experiences, personality traits, social pressure, and norms and rules, as well as a social partner's actions, all may influence an individual's actions and the overall course of social interaction. In some cases, various causes may work in concert. In other cases, opposing forces may be at play. Advanced understanding of social interaction therefore requires the ability to integrate multiple pieces of information and reason about relations among diverse potential causal factors.

Reasoning about multiple causes has been conceptualized in terms of causal schemas and rules of inference (Kelley, 1972). Kelley proposed that when faced with multiple causal factors, people may apply either the multiple necessary causes schema or the multiple sufficient causes schema. According to the multiple necessary causes schema, several factors acting at once are needed to bring about a particular outcome. According to the multiple sufficient causes schema, any one of several factors acting by itself could cause an outcome. By fourth-grade children make judgements consistent with the multiple sufficient causes schema (Smith, 1975). Kelley also proposed that observer's may discount the effect of one possible cause to the extent that other potential causes are present. Alternatively, if an effect occurs in the presence of an inhibitory factor, observer's augment the strength of possible facilitative causes.

Developmental research has focused mainly on children's use of the discounting principle when presented with information about a potential internal cause for a behavior (e.g., child's own preference) and a potential external cause (e.g., parental commands). Most studies have found that children do not apply the discounting principle before 7- to 9-years of age (see Miller and Aloise, 1990 for a review). In fact, younger children sometimes use an additive rule, according to which an external cause enhances the strength of the internal cause. Use of the discounting principle appears to be related to social knowledge, particularly knowledge about types of motives. For example, children who recognize manipulative intent

are more likely to use the discounting principle (Cohen, Gelfand, and Hartmann, 1981; Karniol and Ross, 1979). Thus, children's understanding of psychological functioning may contribute to their ability to reason about multiple causal factors.

INFERRING THE CONSEQUENCES OF SOCIAL ACTS

Social interactions may have social and psychological consequences not only for the participants, but also for onlookers and other individuals or groups who are socially related to the participants. By late childhood, children expect social acts to have particular social consequences. For instance, fourth- and sixth-grade children expect victims of aggression to retaliate, and second- and fourth-grade children expected witnesses of aggression to inform an authority figure of the event (Rogers and Tisak, 1996). Likewise, 10- and 11-year-olds expect both modest and immodest behavior to influence others' evaluation of an actor (Banerjee, 2000; Watling and Banerjee, 2007). Children from kindergarten through fourth-grade predict that prosocial and antisocial behavior results in different evaluations within the peer group, and second- and fourth-grade children recognize that a person's reputation may be based on gossip about the person's social behavior, as well as on firsthand experience (Hill and Pillow, 2002).

Children also recognize that social acts may have psychological consequences for the actor. From ages 7- to 12-years, children expect that failure to engage in prosocial behavior, such as failing to help, comfort, or share with a friend, could result in feeling bad about oneself. Furthermore, children also predicted that others' disapproval of failure to help or share would bother them (Jackson and Tisak, 2001).

Children's goal attributions imply that during late childhood and adolescence they are aware of a range of possible outcomes for social acts. When explaining interpersonal actions, adolescents appeal to social and psychological goals, including making friends, making another person happy, making oneself feel good about oneself, obtaining forgiveness from someone else, causing one person to disapprove of another person, etc. (Pillow et al., 2008.). The fact the adolescents view these social and psychological outcomes as motives for social acts suggests that adolescents consider them to be possible outcomes of social interactions.

COORDINATING MULTIPLE PERSPECTIVES ON SOCIAL EVENTS

For the most part, participants in an interaction experience the same events as their exchange unfolds; however, they may not experience them in the same way. In some circumstances adult actors and observers explain actions in different ways. For example, actors offer more reason explanations than do observers, and when giving reason explanations actors refer to beliefs more often than desires, whereas observers give more causal history explanations and appeal to desires more when giving reason explanations (Malle et al., 2007). These attributional asymmetries suggest that actors and observers view actions from distinct perspectives. Within a social interaction participants shift roles continuously from actor to recipient or observer, and may act simultaneously, possibly in a collaborative or competitive

manner. Consequently, participants' perspectives may intertwine and roles may overlap, making it difficult to define a single consistent perspective for each participant. For interactions that are lengthy or involved, participants' views of the interaction may be complex. Identifying key differences and similarities in participants' understanding of their own experience may provide insight into their social interaction. Tracking participants' perspectives during a social interaction would include (a) identifying their interpretations of specific events, (b) identifying their beliefs about each other's mental states, and (c) determining their affective responses to overt events and social partner's inferred mental states.

Young children recognize some basic differences in perspective. By 4-years of age children know that individuals may differ in their beliefs, desires, intentions, and emotions (see Flavell and Miller, 1998; Harris, 2006 for reviews). However, many differences in perspective may be difficult for young children to grasp. Before the age of 6- or 7-years, children have difficult understanding that two people may view the same object or event, but interpret it in different ways. Both Chandler and Helm (1984) and Taylor (1988; Taylor, Cartwright, and Bowden, 1991) reported that prior to 6- or 7-years of age, children who had viewed a drawing in its entirety failed to recognize that another observer who saw only a small portion of the drawing through an aperture would not be able to identify objects in the drawing. Furthermore, Carpendale and Chandler (1996) found that 7- and 8-year-olds understood that ambiguous stimuli could be interpreted differently by different observers, but 5- and 6-year-olds did not.

A similar pattern of performance has been found when children are asked to identify an observer's interpretation of ambiguous actions, rather than ambiguous drawings (Pillow, 1991). To investigate children's understanding that prior expectations may bias the interpretation of social events, children ages 4 to 8 years were told stories in which one character, the actor, performed an action that could be interpreted in either of two ways (e.g., as taking a toy out of a charity donation box or putting a toy into the box). Two other characters, the observers, held contrasting biases concerning the actor (one liked the actor, the other did not). When asked what action each observer thought the actor was performing, both 6- and 8-year-olds correctly attributed negative interpretations to negatively biased observers and positive interpretations to positively biased observers. Four-year-olds responded randomly, despite remembering the information in the stories. Pillow and Weed (1995) found similar results with simplified stories that included only one observer.

By 7- or 8-years of age children also recognize that self-interest may influence a person's construal of an event. Mills and Keil (2005) reported that second grade children rate statements that fit a speaker's self-interest as less believable than statements that are clearly true or statements that go against the speaker's self-interest. In contrast, kindergarten children rated self-interested statements as more believable than statements contrary to self-interest. When asked to explain why a speaker made a false statement, children from kindergarten through fourth-grade typically viewed self-interested falsehoods as lies, rather than as manifestations of unwitting bias. Sixth grade children proposed lying and bias about equally often as explanations of self-interested false statements. Mills and Keil suggested that prior to sixth grade children may not understand unconsciousness, and therefore find it difficult to conceive of biased interpretation as an unconscious and unintentional process.

Social acts may have contrasting affective meanings for different individuals. Even when social partners represent an event similarly, the event's emotional significance may differ.

Prior to 8-years of age children have difficulty understanding individual differences in emotional responses to the same situation. For example, Gnepp and Gould (1985) investigated children's use of contextual information to make personalized inferences of emotion (i.e., using personal information about an individual to infer his or her emotional reaction to an event). When told about prior event that could color a story character's response to a second event (e.g., a child's best friend previously said, "I don't like you anymore" and then the child saw the best friend on the playground), 10-year-olds and adults judged that the character's emotional reaction would to the second event would be influenced by the prior event (e.g., judging that the child would be sad when seeing the best friend). Seven- and 8-year-olds made personalized much of the time, but not as often as older children, and 5-year-olds rarely made personalized inferences. Likewise, younger children often overlook information about an individual's personality traits when judging emotional reactions (Gnepp and Chilamkurti, 1988).

In addition to interpreting each other's actions, participants in a social interaction may have beliefs about each other's beliefs, intentions regarding each other's intentions, etc. These second-order mental states consist of an embedding of one mental state within another (e.g., Person A thinks that Person B thinks X is true). Many studies find that children have difficulty reasoning about second-order mental states prior to 6- or 7-years of age. For example, when told that both John and Mary wanted to buy ice cream, and that both John and Mary knew the ice cream truck would be at location B, but John believed that Mary thought the truck would be at its previous location A, 5-year-olds typically failed to predict that John would look for Mary at location B (Permer and Wimmer, 1985). Subsequent studies have found that with simplified stories and direct questioning about the story character's ignorance as well as beliefs, 4- and 5-year-olds show some ability to reason about second-order beliefs (Coull, Leekam, and Bennett, 2006; Sullivan, Zaitchik, and Tager-Flusberg, 1994).

Because reasoning about second-order mental states entails coordinating two perspectives, this type of reasoning could be particularly useful for understanding social interactions. Second-order mental state reasoning appears to be related to other aspects of social understanding. Shiverick and Moore (2007) asked children ages 5- to 10-years and adults to infer both an observer's belief about an actor's intention and the observer's evaluation of the actor's action. Children and adults assumed that the observer's evaluation would depend on the observer's second-order belief about the actor's intention. For example, participants reasoned that a teacher who attributed a positive intention to a student would have a positive evaluation of the student's action, whereas a teacher who attributed a negative intention to the actor would have a negative evaluation. Thus, children as young as kindergarten use second-order mental state reasoning to infer another person's moral judgment. Moreover, children's own evaluation of the action often differed from the evaluation they attributed to the teacher, a finding that indicates that children recognize different perspectives on the same actions. Other studies have found that children's appreciation of non-literal language is related to understanding of second-order mental states. Second-order mental state reasoning is required for the ability to distinguish ironic jokes from lies (Sullivan, Winner, and Hopfield, 1995).

Some aspects of social understanding appear to require achievements beyond second-order mental state reasoning. Noting that there is a lag of approximately two years between the development of second-order reasoning and distinguishing lies from jokes, Sullivan, Winner, and Tager-Flusberg (2003) suggested that although second-order mental state

reasoning may be necessary for understanding some forms of non-literal language, it is not sufficient. Likewise, even children who demonstrate second-order mental state reasoning have difficulty understanding the perspective of a speaker who unwittingly makes a social faux pas. Baron-Cohen, O’Riordan, Stone, Jones, and Plaisted (1999) presented 7- to 11-year-old children with stories in which one character committed a faux pas, such as mistaking a girl for a boy, or making derogatory comments about the curtains in a friend’s new room without realizing that the friend had just chosen the curtains at the store earlier in the day. Children were asked if anything inappropriate had been said. Despite passing a test of second-order mental state reasoning, 7-year-olds often failed to detect the faux pas and 9-year-olds continued to make some errors. Faux pas detection involves awareness of two contrasting perspectives on a social act. The actor does not intend harm and is not aware of circumstances that would make his or her remarks offensive to the recipient. The recipient is aware of those circumstances and the recipient’s feelings are hurt. Complete understanding of the event therefore requires second-order reasoning about both actor and recipient perspectives, as well as consideration of knowledge, intentions, and emotions. Children’s appreciation of the actor’s and recipient’s perspectives on the faux pas has not been assessed in detail.

FROM UNDERSTANDING SOCIAL ACTS TO UNDERSTANDING SOCIAL INTERACTIONS: QUESTIONS AND SPECULATIONS

During the elementary school years children develop some of the concepts needed to comprehend social interactions. That is, children reason about others’ knowledge, beliefs, desires, intentions, and emotions, recognize that these mental states may vary across individuals, and understand that mental states and personality traits influence behavior. Children also are beginning to reason about multiple perspectives on the same event. Thus, children recognize that individuals may interpret the same event in different ways and experience different emotional responses to the same event, and children also begin to conceptualize one person’s thoughts about another person’s thoughts. In addition, by late childhood or early adolescence a sophisticated understanding of the social and psychological goals motivating interpersonal acts begins to emerge. Children begin to conceive of social acts as being aimed at influencing either the actor’s own mental state or another person’s mental state. This recognition of actions and thoughts as being aimed at another person’s actions or thoughts is a step toward understanding social events as interactive.

Further progress toward understanding social interactions as contingent exchanges of social acts with mutual influence between participants would require the ability to track sequences of social acts and changes mental states as an interaction unfolds, and to consider two or more perspectives. When observing an interaction, older children, adolescents, and adults might represent each participant’s actions and thoughts at key points in the exchange by alternating between each participant’s perspective. For example, first Person A thought X and did Y, and then Person B thought W and did Z, etc. The sequence of actions and mental states might be represented without interpersonal causal links. Perceiving causal connections between the two participants, such as Person A’s action caused Person B’s thought, would constitute further awareness of the exchange as interactive. Simultaneously thinking about both perspectives might lead to the additional insight that Person A and B influenced each

other. Such a progression is speculative at present. Current research typically has examined children's understanding of a single social act. Therefore, the development of an understanding of social exchanges as interactive remains to be investigated.

Key issues to be addressed include: (a) describing age-related changes in children's understanding of social interaction from middle childhood through adolescence, (b) examining possible individual differences in concepts of social interaction, (c) examining developmental and functional relations between social information processing during interactions and concepts of social interaction, and (d) investigating factors that influence the development of children's understanding of social interaction. Describing age-related changes in children's understanding of social interaction will entail presenting children with stories that involve an exchange of a sequence of social acts and questioning children in detail about each character's role in the exchange. Because such stories would be more involved than the single event vignettes employed in many social cognitive studies, they will draw upon narrative comprehension abilities as well as social understanding. Research and theory on narrative comprehension likely will be prove insightful in the design of such studies (e.g., Egidi and Gerrig, 2006; Trabasso and Wiley, 2005).

Individual differences in social cognition have been assessed in studies comparing clinical and non-clinical populations and in studies examining variations within non-clinical samples. For example, aggressive children have been found to differ from their non-aggressive peers in social information performance, including encoding and interpretation of social cues, selection of social goals, and selection of responses to social events (for a review see Crick and Dodge, 1994). Children with autism have been found to have difficulty with a variety of social cognitive tasks, including reasoning about first- and second-order beliefs.(e.g., Baron-Cohen et al, 1999; Happe, 1994). In addition, within non-clinical populations there are variations in emotional understanding and attributional style (e.g., Fincham et al., 2000). Because understanding social interactions as contingent, bidirectional exchanges is an advanced social cognitive achievement, the development of such understanding may be less than universal even among adults. Moreover, those individuals who develop a sophisticated conception of social interaction may not utilize it consistently over time or across situations. Therefore, investigating the nature and origins of individual differences in both clinical and non-clinical populations is an important goal for studies of children's and adults' understanding of social interaction.

Because social cognition is multi-faceted, an adequate account of development must consider relations among different aspects of social cognition. Social cognitive knowledge often is distinguished from social information processing (e.g., Dodge and Schwartz, 1997). Whereas social cognitive knowledge includes stored concepts, knowledge, or schemas concerning psychological functioning and behavior, social information processing refers to perceiving and representing information about an ongoing social event. Dodge's prominent social information processing framework distinguishing among steps in processing social events, from encoding and interpreting social cues to selecting social goals and enacting social responses. This framework has been useful in research aimed at identifying particular information processing steps that differentiate aggressive and non-aggressive children. In addition, Dodge and colleagues have suggested that there may be individual differences in social knowledge or schemas, and that social knowledge and social information processing may influence each other. The distinction between social cognitive knowledge and social information processing also raises the possibility of mutual influence during normative

developmental changes. Advances in social information processing might contribute to conceptualizing social interactions as contingent exchanges with bidirectional influence, and a sophisticated understanding of social interaction may alter patterns of social information processing.

More generally, understanding of social interaction may be influenced by both cognitive and social factors. Cognitive factors that may contribute to the concept of social interaction include information processing capacity, executive function, and general causal schemas. Information processing capacity may constrain the complexity of the concepts that children can construct or the details of events that children process. For example, gradual improvements in processing efficiency have been proposed to benefit cognitive performance across conceptual domains, including social understanding (e.g., Case, 1985; Case and Griffin, 1990). Tracking a social interaction requires integration of the actions of two or more social partners, consideration of each person's thoughts, feelings, desires, and intentions, identification of relations among mental states and relations between mental states and actions, and awareness of changes in state over time. Understanding of social events also may be enhanced by knowledge of the participants' personality traits, past histories, and the current social context of their interaction. Improvements in processing capacity may facilitate integration of this information. Theories of executive function provide another framework for conceptualizing general cognitive influences on the social cognitive development. Executive function has linked to the development of social understanding during early childhood (e.g., Carlson, Mandell, and Williams, 2004). Possible relations between executive function and advanced levels of social understanding, including concepts of social interaction, remain to be investigated. Causal schemas can be applied to interpreting social experiences. A general schema for bidirectional causation would facilitate insight into the contingent nature of social interaction; however, whether people ordinarily construct such a schema or employ it for understanding everyday social experiences are empirical questions.

Children's social experience provides information about their own and others' patterns of social behavior and mental states. In addition, social partners may guide children's attention to and interpretation of social information. Age-related change in social experience could contribute to the development of social understanding. Children begin participating in bidirectional, contingent social interactions during infancy (Moore, 2006). Conversations about mental states with parents, siblings, and peers are related to the growth of young children's social understanding (Brown, Donelan-McCall, and Dunn, 1996). However, during late childhood and adolescence social interactions may provide more explicit information about causal patterns. As children's conversations with peers begin to include in depth discussions of social and psychological processes (e.g., Gottman and Mettetal, 1986), older children and adolescents may provide each other with explicit verbal accounts of contrasting perspectives on social events. Such accounts may include attributions about the causes of the child's own social acts and others' social acts. In addition, as children mature, parents, teachers, and other adults may express increasingly sophisticated attributions about children's social behavior. These attributions may draw children's attention to the causes and consequences of their and others' behavior, and may facilitate recognition that children's actions are influenced by others actions and also influence others actions. As a result, children may begin to appreciate patterns of contingency and mutual influence during social interactions. Eventually, an explicit concept of bidirectional, contingent social exchanges may develop.

The development of children's and adolescents' concepts of social interaction is a promising, but largely unexplored, area for social cognitive investigation. Research should describe age-related changes in children's understanding of social interaction, and explore how the intersection of children's cognitive abilities and social experiences leads to the emergence of new insights into social processes.

REFERENCES

- Banerjee, R. (2000). The development of an understanding of modesty. *British Journal of Developmental Psychology*, 18, 499-517.
- Banerjee, R., and Yuill, N. (1999). Children's explanations for self-presentational behavior. *European Journal of Social Psychology*, 29, 105-111.
- Baron-Cohen, S., O'Riordan, M., Jones, R., Stone, V., and Plaisted, K. (1999). A new test of social sensitivity: Detection of faux pas in normal children and children with Asperger syndrome. *Journal of Autism and Developmental Disorders*, 29, 407-418.
- Bartsch, K., Campbell, M. D., and Troseth, G. L. (2007). Why else does Jenny run? Young children's extended psychological explanations. *Journal of Cognition and Development*, 8, 33-61.
- Bartsch, K. and Wellman, H. M. (1989). Young children's attribution of action to beliefs and desires. *Child Development*, 60, 946-64.
- Bartsch, K. and Wellman, H. M. (1995). *Children Talk About the Mind*. New York: Oxford University Press.
- Bennett, M. and Yeeles, C. (1990a). Children's understanding of showing off. *The Journal of Social Psychology*, 130, 591-596.
- Bennett, M. and Yeeles, C. (1990b). Children's understanding of the self-presentational strategies of ingratiation and self-promotion. *European Journal of Social Psychology*, 20, 455-461.
- Berndt, T. J., and Berndt, E. G. (1975). Children's use of motives and intentionality in person perception and moral judgment. *Child Development*, 46, 904-912.
- Berndt, T. J., and Heller, K. A. (1986). Gender stereotypes and social inferences: A developmental study. *Journal of Personality and Social Psychology*, 50, 889-898
- Brown, J. R., Donelan-McCall, N., and Dunn, J. (1996). Why talk about mental states? The significance of children's conversations with friends, siblings, and mothers. *Child Development*, 67, 836-849.
- Carlson, S. M., Mandell, D. J., and Williams, L. (2004). Executive function and theory of mind: Stability and prediction from age 2 to 3. *Developmental Psychology*, 40, 1105-1122.
- Carpendale, J. I., and Chandler, M. J. (1996). On the distinction between false belief understanding and subscribing to an interpretative theory of mind. *Child Development*, 67, 1686-1706.
- Case, R. (1985). *Intellectual development: Birth to adulthood*. New York: Academic Press.
- Case, R., and Griffin, S. (1990). Child cognitive development: The role of central conceptual structures in the development of scientific and social thought. In C. A. Hauert (Ed.),

- Advances in psychology, developmental psychology (pp. 193-230). Amsterdam, The Netherlands: Elsevier.
- Chandler, M. and Helm, D. (1984). Developmental changes in the contributions of shared experience to social role-taking competence. *International Journal of Behavioral Development*, 7, 145-156.
- Cohen, E. A., Gelfand, D. M., and Hartmann, P. P. (1981). Causal reasoning as a function of behavioral consequences. *Child Development*, 52, 514-522.
- Coull, G. J., Leekam, S. R., and Bennett, M. (2006). Simplifying second-order belief attribution: What facilitates children's performance on measures of conceptual understanding? *Social Development*, 15, 548-563.
- Dodge, K. A., and Schwartz, D. (1997). Social information processing mechanisms in aggressive behavior. In D. M. Stoff, J. Breiling, and J. D. Maser (Eds.), *Handbook of antisocial behavior*. New York: John Wiley and Sons, 171-180.
- Egidi, G., and Gerrig, R. J. (2006). Readers' Experiences of Characters' Goals and Actions. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 32, 1322-1329.
- Feinfield, K. A., Lee, P. P., Flavell, E. R., Green, F. L., and Flavell, J. H. (1999). Young children's understanding of intention. *Cognitive Development*, 14, 463-486.
- Fincham, F. D., Harold, G., and Gano-Phillips, S. (2000). The longitudinal relation between attributions and marital satisfaction: Direction of effects and role of efficacy expectations. *Journal of Family Psychology*, 14, 267-285.
- Fiske, S. T., and Taylor, S. E. (2007). *Social Cognition: From Brains to Culture*. McGraw-Hill: New York.
- Flavell, J. H. (1993). The development of children's understanding of false belief and the appearance-reality distinction. *International Journal of Psychology*, 28, 595-604.
- Flavell, J. H., and Miller, P. H. (1998). Social cognition. In W. Damon (Series Ed.), D. Kuhn and R. S. Siegler (Eds.), *Handbook of child psychology: Vol. 2. Cognition, perception, and language* (5th ed., pp. 851-898).
- Gnepp, J. and Chilamkurti, C. (1988). Children's use of personality attributions to predict other people's emotional and behavioral reactions. *Child Development*, 59, 743-754.
- Gnepp, J. , and Gould, M. E. (1985). The development of personalized inferences: Understanding other people's emotional reactions in light of their prior experiences. *Child Development*, 56, 1455-1464.
- Gottman, J. M., Katz, L. F., and Hooven, C. (1996). Parental meta-emotion philosophy and the emotional life of families: Theoretical models and preliminary data. *Journal of Family Psychology*, 10, 243-268
- Gottman, J. M., and Mettetal, G. (1986). Speculations about social and affective development: Friendship and acquaintanceship through adolescence. In J. M. Gottman and J. G. Parker (Eds.), *Conversations of friends: Speculations on affective development* (pp. 192-240). New York: Cambridge University Press.
- Happe, F. (1994). An advanced test of theory of mind: Understanding of story characters' thoughts and feelings by able autistic, mentally handicapped, and normal children and adults. *Journal of Autism and Developmental Disorders*, 24, 129-154.
- Harris, P. L. Social Cognition. In W. Damon, and R. M. Lerner (Series Eds.), D. Kuhn and R.S. Siegler (Vol. Eds.), *Handbook of Child Psychology: Vol. 2. Cognition, perception, and language* (6th ed.) (pp. 811-858) New York, Wiley.

- Heyman, G. D., and Gelman, S. A. (1998). Young children use motive information to make trait inferences. *Developmental Psychology*, 34, 310-321.
- Hill, V., and Pillow, B. H. (2006). Children's understanding of reputations as shared beliefs. *The Journal of Genetic Psychology*, 167, 137-157.
- Jackson, M., and Tisak, M. S. (2001). Is prosocial behavior a good thing? Developmental changes in children's evaluations of helping, sharing, cooperating, and comforting. *British Journal of Developmental Psychology*, 19, 349-367.
- Juvonen, J., and Murdock, T. B. (1995). Grade-level differences in the social value of effort: Implications for self-presentation tactics of early adolescents. *Child Development*, 66, 1694-1705.
- Kalish, C. W. (2002). Children's predictions of consistency in people's actions. *Cognition*, 84, 237-265.
- Kalish, C. W., and Shiverick, S. M. (2004). Children's reasoning about norms and traits as motives for behavior. *Cognitive Development*, 19, 401-416.
- Karniol, R., and Ross, M. (1979). Children's use of a causal attribution schema and the inference of manipulative intent. *Child Development*, 50, 463-469.
- Kelley, H. H. (1972). Causal schemata and the attribution process. In E. E. Jones, D. E. Kanouse, H. H. Kelley, R. E. Nisbett, S. Valins, and B. Weiner (Eds.), *Attribution: Perceiving the causes of behavior* (pp. 151-174). Morristown, NJ: General Learning Press.
- Liu, D., Gelman, S. A., and Wellman, H. M. (2007). Components of young children's trait understanding: Behavior-to-trait inferences and trait-to-behavior predictions. *Child Development*, 78, 1543-1558.
- Malle, B. F., Knobe, J. M., and Nelson, S. E. (2007). Actor-observer asymmetries in explanations of behavior: New answers to an old question. *Journal of Social and Personality Psychology*, 93, 491-514.
- Miller, P. H. (1985). Children's reasoning about causes of human behavior. *Journal of Experimental Child Psychology*, 39, 343-362.
- Miller, P. H., and Aloise, P. A. (1989). Young children's understanding of the psychological causes of behavior: A review. *Child Development*, 60, 257-285.
- Miller, P. H., and Aloise, P. A. (1990). Discounting in children: The role of social knowledge. *Developmental Review*, 10, 266-298.
- Miller, P. H., and DeMarie-Dreblow, D. (1990). Social-cognitive correlates of children's understanding of displaced aggression. *Journal of Experimental Child Psychology*, 49, 488-504.
- Mills, C., M., and Keil, F. C. (2005). The development of cynicism. *Psychological Science*, 16, 385-390.
- Moore, C. (2006). *The Development of Commonsense Psychology*. Mahwah, NJ: Lawrence Erlbaum Associates.
- Perner, J. (1991). *Understanding the Representational Mind*. Cambridge, MA: The MIT Press
- Perner, J., and Wimmer, H. (1985). "John thinks that Mary thinks that ...": Attribution of second-order beliefs by 5- to 10-year-old children. *Journal of Experimental Child Psychology*, 39, 437-471.
- Pillow, B. H. (1991). Children's understanding of biased social cognition. *Developmental Psychology*, 27, 539-551.

- Pillow, B. H., and Henrichon, A. J. (1996). There's more to the picture than meets the eye: Young children's difficulty understanding interpretation. *Child Development*, 67, 808-819.
- Pillow, B. H., Lovett, S. B., and Hill, V. (2008). Children's, adolescents', and adults' explanations of interpersonal actions. *Infant and Child Development*, 17, 471-489.
- Pillow, B. H., and Weed, S. T. (1995). Children's understanding of biased interpretation: Generality and limitations. *British Journal of Developmental Psychology*, 13, 347-366.
- Rholes, W. S. and Ruble, D. N. (1984). Children's understanding of dispositional characteristics of others. *Child Development*, 55, 550-560.
- Rogers, M. J., and Tisak, M. S. (1996). Children's reasoning about responses to peer aggression: Victim's and witnesses expected and prescribed behaviors. *Aggressive Behavior*, 22, 259-269.
- Rotenberg, K. J. (1980). Children's use of intentionality in judgments of character and disposition. *Child Development*, 51, 282-284.
- Rubin, K. H., Bukowski, W. M., and Parker, J. G. (2006). Peer interactions, relationships, and groups. In W. Damon, and R. M. Lerner (Series Eds.), N. Eisenberg (Vol. Ed.), *Handbook of Child Psychology: Vol. 3. Social, emotional, and personality development* (6th ed.) (pp. 571-645) New York, Wiley.
- Shaw, L. A., and Wainryb, C. (1999). The outsider's perspective: Young adults' judgments of the social practices of other cultures. *British Journal of Developmental Psychology*, 17, 451-471.
- Shiverick, S. M. and Moore, C. F. (2007). Second-order beliefs about intentions and children's attributions of sociomoral judgment. *Journal of Experimental Child Psychology*, 97, 44-60.
- Shultz, T. R., and Wells, D. (1985). Judging the intentionality of action-outcomes. *Developmental Psychology*, 21, 83-89.
- Smith, M. C. (1975). Children's use of the multiple sufficient cause schema in social perception. *Journal of Personality and Social Psychology*, 32, 737-747.
- Sullivan, K., Winner, E., and Hopfield, N. (1995). How children tell a lie from a joke: The role of second-order mental attributions. *British Journal of Developmental Psychology*, 13, 191-204.
- Sullivan, K., Winner, E., and Tager-Flusberg, H. (2003). Can adolescents with Williams syndrome tell the difference between lies and jokes? *Developmental Neuropsychology*, 23, 85-103.
- Sullivan, K., Zaitchik, D., and Tager-Flusberg, H. (1994). Preschooler's can attribute second-order beliefs. *Developmental Psychology*, 30, 395-402.
- Taylor, M. (1988). Conceptual perspective taking: Children's ability to distinguish what they know from what they see. *Child Development*, 59, 703-711.
- Taylor, M., Cartwright, B. S., and Bowden, T. (1991). Perspective-taking and theory of mind: Do children predict interpretive diversity as a function of differences in observers' knowledge? *Child Development*, 62, 1334-1351.
- Trabasso, T., and Wiley, J. (2005). Goal plans of action and inferences during comprehension of narratives. *Discourse Processes*, 39, 129-164.
- Turiel, E. (1998). The development of morality. In W. Damon (Series Ed.) and N. Eisenberg (Volume Ed.), *Handbook of child psychology: Vol. 3. Social, emotional, and personality development* (5th ed., pp. 863-932). New York: Wiley.

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- Wainryb, C., and Ford, S. (1998). Young children's evaluations of acts based on beliefs different from their own. *Merrill-Palmer Quarterly*, 44, 484-503.
- Watling, D., and Banerjee, R. (2007). Children's understanding of modesty in front of peer and adult audiences. *Infant and Child Development*, 16, 227-236.
- Wellman, H. M. (1990). *The child's theory of mind*. Cambridge, MA: MIT Press.
- Wellman, H. M., and Bartsch, K. (1988). Young children's reasoning about beliefs. *Cognition*, 30, 239-277.
- Yuill, N. (1990). Children's conception of personality traits. *Human Development*, 35, 265-279.

Chapter 16

**THE INFLUENCE OF SOCIAL DOMINANCE
ORIENTATION ON STATE CONCEPT AND ATTITUDES
TOWARDS IMMIGRANT INCLUSION: A STUDY ON
ITALIAN SOCIETY**

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ABSTRACT

Social Dominance theory (Sidanius, and Pratto, 1999) posit that all human societies are organised in group-based hierarchical systems. Group-based hierarchy often produces discrimination and domination. Social Dominance Orientation (SDO) is considered a personality variable that measures a general individual orientation to accept hierarchy, and consequently to justify discrimination and domination between groups, within any given social system.

In modern Western Countries societies, SDO can influence attitudes towards immigrants also in respect of their acceptance or refusal as new citizens. The meanings that people attribute to citizenship lie on specific conceptions about the nature of social contract between the individuals and the State. This one can be perceived as a champion of the defence of ingroup (citizens) privileges against the challenging outgroup (settled immigrants), or a social entity based on participation and solidarity towards the weaker social categories that compose it, including settled immigrants.

The study involved 239 adult Italians (average age = 45.51; S.D. =15.03). The basic hypothesis, tested via structural equation model, was that SDO influences conception of the nature and tasks of the State, and attitudes toward multiculturalism (acceptance vs. refusal of cultural differences) that, in turn, influence majority members attitudes towards the inclusion of settled immigrants in the ingroup. This last variable was operationalized by means of the agreement to grant to immigrants the right to vote in general elections.

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As expected, results showed that SDO influences a negative attitude towards multiculturalism and a penal State concept. This conception of the State influences the agreement with concession of the right to vote to legal immigrants but, contrary to our first hypothesis, attitude toward multiculturalism do not.

Keywords: *SDO, Citizenship, Multiculturalism, SEM.*

The issue of migration in the contemporary world is a highly relevant and complex domain of research, where a plurality of actors, scenarios, social and psychological dynamics must be considered. Contemporary migration fluxes involve more of the population than in the past, triggering unstoppable and unavoidable processes of social change. Immigrant settlement in Europe is quite recent, differently from that of the ‘new world’ countries, like the USA, Canada, or Australia. Indeed, the massive entrance of new cultural references into a previously mono-cultural framework, necessitate that these societies reorganise their ideas of themselves, bringing into play a reinterpretation of their socio-cultural reference frames. Societies are, however, not abstract entities, in as much as they are made up of real people that consider immigrants to be deeply menacing to their identity as cultural and national groups, as a result of the indissoluble relationship between identity and culture (Geertz, 1996, 1983). Consequently, many Europeans feel that the century-old process of identification in a nation-state and in its correlates of cultural and value references, is now being challenged. This feeling arouses both old and new fears involving attitudes towards diversity and attitudes towards intergroup relations.

The aim of this paper is to investigate the relationships among psychological dimensions that originate in the fears generated by today’s multiethnic societies. Particular emphasis was placed on: (a) at the social level the concept of citizenship i.e. the conception of the function and boundaries of the state, the basis of the inclusion, or exclusion of a newcomer and (b) at individual level, on the concept of Social Dominance Orientation, a personality trait related to the management of social anxiety.

MULTICULTURALISM AND INTERETHNIC RELATIONS

Social psychology can observe this complex set of phenomena “through the lenses” of ethnic relationships and acculturation frameworks. The term “ethnic” instead of “intergroup” implies that relationships involve groups of an essentially cultural nature (Berry, 2005). This area includes a number of constituent concepts, such as stereotypes, attitudes, prejudice, multiculturalism and security. Acculturation is the dual process of cultural and psychological change that takes place as a result of contact between two or more cultural groups and their individual members, involving various forms of mutual accommodation between groups (Graves, 1967; Redfield, Linton, and Herskovits 1936). Whilst changes at the individual level involve individual behavioural repertoire, at the group level they take place in social structure and/or in institutions, as well as in cultural practices (Berry, 2006). Although these two domains of research look at the field from different perspectives, they do address the same set of phenomena and are highly related : «First, for any particular society, they are both situated

in a common historical, sociocultural and political context, which shapes the character of intercultural relationships. Second, both domains contribute to intergroup outcomes that range from harmonious to conflictual relationships. Third, in both domains, there are theoretical and empirical links between many of the elements» (Berry, 2006, p. 720).

One of the major changes that a monocultural receiving society may afford is that of considering itself multicultural, accepting diversity as a feature of the society as a whole. However, a plural society cannot be founded on the mere presence of many independent cultural communities within a society, without their equitable participation and incorporation. Otherwise, it would be necessary for non-dominant groups in multicultural plural societies to adopt the basic values of the larger society, whilst the dominant group must be prepared to adapt national institutions (e.g.: education, labour, health) to better meet the needs of all groups living together. In fact, the concept of multiculturalism implies two important and interrelated dimensions. One of these refers to the maintenance of heritage cultures and identities and the other, to the full and fair participation of all ethno-cultural groups in the life of the society as a whole. This would imply that immigrants be accepted as full society members and not merely as temporary sojourners.

CITIZENSHIP: A DOUBLE-FACETED CONCEPT

Citizenship refers to a “moving boundary” that originates from a process through which groups, rights and the balance of society are constantly on the move and re-defined (Campomori, 2008). In these terms, citizenship may be considered a double-faceted concept. On the one hand it presents itself as a factor of inclusion and equality. From this point of view, the boundaries of the ingroup are functional both to membership and to the development of a sense of loyalty towards the institutions. On the other, it is an instrument of exclusion and social closure, whilst the same boundaries allow for a clear distinction between the *insiders*, who belong to the community of citizens and the *outsiders*. This is particularly true in such countries as Italy, where citizenship is ruled by a *ius sanguinis* (i.e. a blood right principle)¹. Therefore, for the immigrant, in this case, the right of citizenship is more an instrument of exclusion rather than one of inclusion (Martiniello, 1997).

The issue of enlargement of rights is of great interest for contemporary western societies. According to Dahrendorf (1988), the challenge of the modern era is between economic growth and social justice. Two opposite ideological perspectives emerge from this challenge: the one supports provision development (resources, economic wealth yielded) and the other supports the enlargement of the entitlements. Some European societies have recently granted a certain number of rights to immigrants. However, if immigrants are entitled to such rights in a fairly homogeneous way amongst the different countries, their real endowment is highly conditioned by the local and national policies. Moreover, it must be noted that only in few

¹ There are two modalities by which an immigrant may become an Italian citizen: (a) *ius connubi*, through marriage with an Italian citizen; (b) *ius domicilii*, after a number of years of continuous residence and work in the country (10 years for non EU citizens, 5 years for EU citizens). In the *ius domicilii* case access to citizenship is submitted to a discretionary decision made by an authoritative committee. Children born in Italy from non Italian parents are not automatically Italian citizens.

countries are immigrants, even if long-residing, entitled to some political rights that are fundamental to policy formulation and implementation.

The theme of rights goes together with that of duties: both are the pillars of the social contract between the individual and the state and define the role and the limits for their actions. However, as Spini and Doise (2004) note, «definitions of rights and duties are not symmetrical, as they depend on two basic ideologies that defend either the primacy of the community, emphasizing the concrete duties of individuals, or the primacy of the rights of the individual, stressing the duties of the state» (p. 23). These two contrasting ideologies, that found relationships between the individual and the state, are rooted in an ancient debate. It opposes the principles of nature to that of society, affirming in the latter the supremacy of public order over the freedom of individuals. Different studies carried out in the realm of attitudes towards human rights (Clémence, Doise, De Rosa, and Gonzalez, 1995; Diaz-Veizades, Widaman, Little and Gibbs, 1995; Devos, Spini, and Schwartz, 2002; Moghaddam and Vucksanovic, 1990) have shown that individuals hold specific reference frames on which they base the evaluation of the action of their own government. On the one hand, general agreement towards the restriction of individual rights in order to guarantee the functioning of society are shared by those who refer themselves to values of conservation, related to tradition, security and right-wing political preference. On the other, a critical evaluation and a personal concern for human rights are typically shown by the supporters of universalistic, or self-enhancement values, as well as by those committed to social change (Spini and Doise, 2004).

SOCIAL DOMINANCE ORIENTATION: AN INDIVIDUAL POINT OF VIEW ON INTERGROUP RELATIONSHIPS

The Social Dominance theory moves from the assumption that group conflict and group-based inequality are pervasive in human existence (Pratto, Sidanius, Stallworth, and Malle, 1994). In summary, the theory postulates that societies minimize group conflict by creating consensus on ideologies, termed hierarchy legitimizing myths, that promote the superiority of one group over others (Sidanius and Pratto, 1999). The role of these ideologies – e.g.: ethnic prejudice, nationalism, cultural elitism, meritocracy, political-economic conservatism, support of punitive policies – is to «minimize conflict among groups by indicating how individuals and social institutions should allocate things of positive, or negative social value» (Pratto et al., 1994, p. 741). Legitimizing myths either enhance, or maintain the degree of social inequality; other ideologies may serve to attenuate the amount of social inequality that affects human societies and explicitly refer to egalitarian and inclusive values. The Social Dominance theory postulates the existence of a central individual-difference variable, known as Social Dominance Orientation (SDO), that predicts an individual's acceptance, or rejection of numerous ideologies and policies concerning group relationships. In fact, SDO is defined as a general attitudinal orientation towards intergroup relationships, reflecting whether one generally prefers such relationships to be equal (low SDO), versus hierarchical (high SDO). In other words, SDO justifies attitudes towards policy support, enabling people to justify their attitudes towards these policies that reflect their values about intergroup relationships (Pratto, Stallworth, Conway-Lanz, 1998).

OBJECTIVES AND HYPOTHESIS

The basic idea behind this paper envisaged SDO as the core variable influencing peoples' attitudes towards the immigrant's social and political inclusion. Therefore, so as to test this hypothesis, we considered that behaviour towards immigrants inclusion is not only related to general attitudes towards multicultural societies, but also to peoples' conception of the state's social functions, expressed through the agreement (vs. disagreement) to Penal State programmes. Specifically, we felt that the support of security and crime-related policies (Penal State) may be considered a hierarchy enhancing ideology. Indeed, the positioning towards a policy of security enforcement may be conceived as a means of "defensive exclusion from the public space" (Young, 1999), motivated by fears, which, nowadays, are mostly associated to ethnic minorities (see Hopkins, Reicher, and Kahani-Hopkins, 2003; Sanchez-Mazas, Van Humskerken, and Casini, 2003). On the other hand, we can consider that a positive attitude towards multiculturalism and the acceptance of cultural diversities may be considered as support of social equality. We also took into consideration two variables associated to SDO and attitudes towards multiculturalism and state functioning i.e. the educational level and the political orientation (Pratto et al., 1994).

We theorized a three level variable interaction, represented in figure 1. The individual variables, such as personality traits (SDO), ideology (political orientation) and cultural level (educational level) influence attitudes towards multiculturalism and state functioning, that, in turn, influence behaviour towards immigrant inclusion.

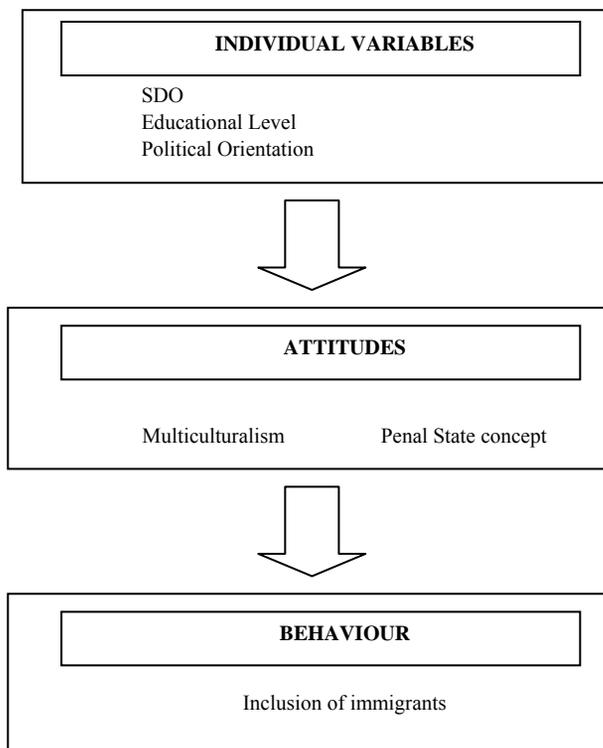


Figure 1. Interaction among variables included in the model.

Given such a theoretical framework, we hypothesized that: (a) SDO has an inverse influence on the attitude towards multiculturalism (acceptance of cultural differences) and a positive influence on both the Penal State concept and right-wing political orientation; (b) educational level has a positive influence on the acceptance of cultural differences and a negative influence on the Penal State concept; (c) SDO and years of education are related; (d) right-wing political orientation has a positive influence on the Penal State concept; (e) both the attitudes towards multiculturalism and the Penal State concept influence majority members attitudes towards the inclusion of settled immigrants into the ingroup of citizens. This last variable was operationalized by agreeing to grant to immigrants one of the most representative symbols of belonging to, and participation in, a modern Nation-State life, i.e. the right to elect the representatives. We hypothesized that the acceptance of cultural differences had a positive influence on this agreement, whereas the Penal State concept had a negative influence on it.

METHOD

The study involved 239 adult Italians residing in the urban area of Turin² (average age = 45.51; S.D. = 15.03; M = 42.7%, F = 57.3%).

Data collection was done by the adoption of a self-reported questionnaire, that took about 20 minutes.

The questionnaire included the following variables.

- 1 *Social Dominance Orientation*. 7 items from the validated Italian SDO item bank (Di Stefano, and Roccato, 2005). We selected items measuring the respondents' attitudes towards intergroup relationships (e. g. "Inferior groups should stay in their place"; "Group equality should be our ideal"). Items were rated on a 5 point Likert-type scale ranging from 1 (*complete disagreement*) to 5 (*complete agreement*). The internal consistency was good ($\alpha = .72$).
- 2 *The Penal State concept*. 8 items measured the respondents' support of security and crime-related policies (e. g.: "The State should bring back the death penalty for the most horrible crimes³"; "The State should reinforce measures able to find and send illegal immigrants away "; Sanchez-Mazas et al., 2003). Items were rated on a 5 point Likert-type scale ranging from 1 (*complete disagreement*) to 5 (*complete agreement*). The internal consistency was good ($\alpha = .81$).
- 3 *Multicultural attitude*. So as to assess the respondents' degree of acceptance of intercultural differences, we included 5 items (e. g.: "I feel annoyed when people don't speak standard Italian", "I don't understand why people of different racial, or ethnic backgrounds enjoy wearing traditional clothing") from the Ethnocultural Empathy Scale (Wang, Davidson, Yakushko, Savoy Bielstein, Tan, and Bleier, 2003). Items were rated on a 5 point Likert-type scale (1 = *completely false*; 5 = *completely true*); internal consistency was good ($\alpha = .77$).

² Turin is a large city in Northwest Italy (approximately 1,000,000 inhabitants).

- 4 *Attitude towards the political inclusion of immigrants* was assessed by a single question asking what the respondents' attitude was towards immigrants being entitled to elect representatives ("In your opinion, is it right to give regular immigrants the right to elect representatives?").
- 5 *Political orientation* on the left-wing/right-wing axis was assessed by a 10 point thermometer (1 = left-wing orientation; 10 = right-wing orientation).
- 6 A brief list of socio-demographic items, including respondents' gender, age and educational qualifications.

To verify the hypothesized relationships between variables we tested a structural equation model, assuming the influences postulated above.

RESULTS

The structural equation model we tested included three single item variables (years of education, political orientation, agreement to give immigrants the right to vote) and three latent variables (SDO, Penal State concept, Multicultural attitude). A partial disaggregating approach (Bagozzi, 1993; Bagozzi and Edwards, 1998) was used for the latent variables, by examining groups of aggregated, rather than single items, as latent variable indicators. That is to say, we limited the numbers of indicators to two for each scale, aggregating the items at random. The advantage of this approach is that it reduces the number of variables in the model that may result in an excessive worsening of the fit, allowing anyway to estimate the measure error of the latent variables.

As recommended (Bollen and Long, 1993; Hu and Bentler, 1998), we tested the model fit using different fit indexes, to attenuate any limits they might have e.g. the χ^2 , CFI (Bentler, 1990), the TLI (Tucker and Lewis, 1973) – also known as the NNFI (Bentler and Bonett, 1980) – and the RMSEA (Steiger, 1990). Values higher than 0.90 were considered satisfactory for CFI and TLI, as indicated by Bentler (1990). RMSEA was calculated according to Browne (1990), who considers values of less than 0.08 to be satisfactory and values of less than 0.05, good.

The first model tested was acceptable according to all the fit indexes: $\chi^2(21) = 35.41$, $p = .025$, $CFI = .98$, $TLI = .97$, $RMSEA = .054$ (90% CL = .019, .084). Since the path linking Multicultural attitude on agreement to grant immigrants to right to vote was not statistically significant, we deleted this relationship. The second model we tested was acceptable according to all the fit indexes: $\chi^2(22) = 35.47$, $p = .035$, $CFI = .98$, $TLI = .97$, $RMSEA = .051$ (90% CL = .014, .080). Moreover, all the parameters were statistically significant. Figure 2 shows the model in graphic form.

SDO was observed to have an inverse influence on Multicultural attitude ($\beta = -.48$) and a positive one on both the Penal State concept ($\beta = .76$) and political orientation ($\beta = .55$). Years of education had a direct influence on Multicultural attitude ($\beta = .21$) and an inverse one on the Penal State concept ($\beta = -.18$). Political orientation influenced the Penal State

³ Death penalty in Italy was expressly forbidden by the Constitution of 1948.

concept ($\beta = .14$). The Penal State concept had a negative influence on agreement to grant immigrants the right to vote ($\beta = -.40$). Lastly, SDO and years of education were inversely related ($r = -.31$).

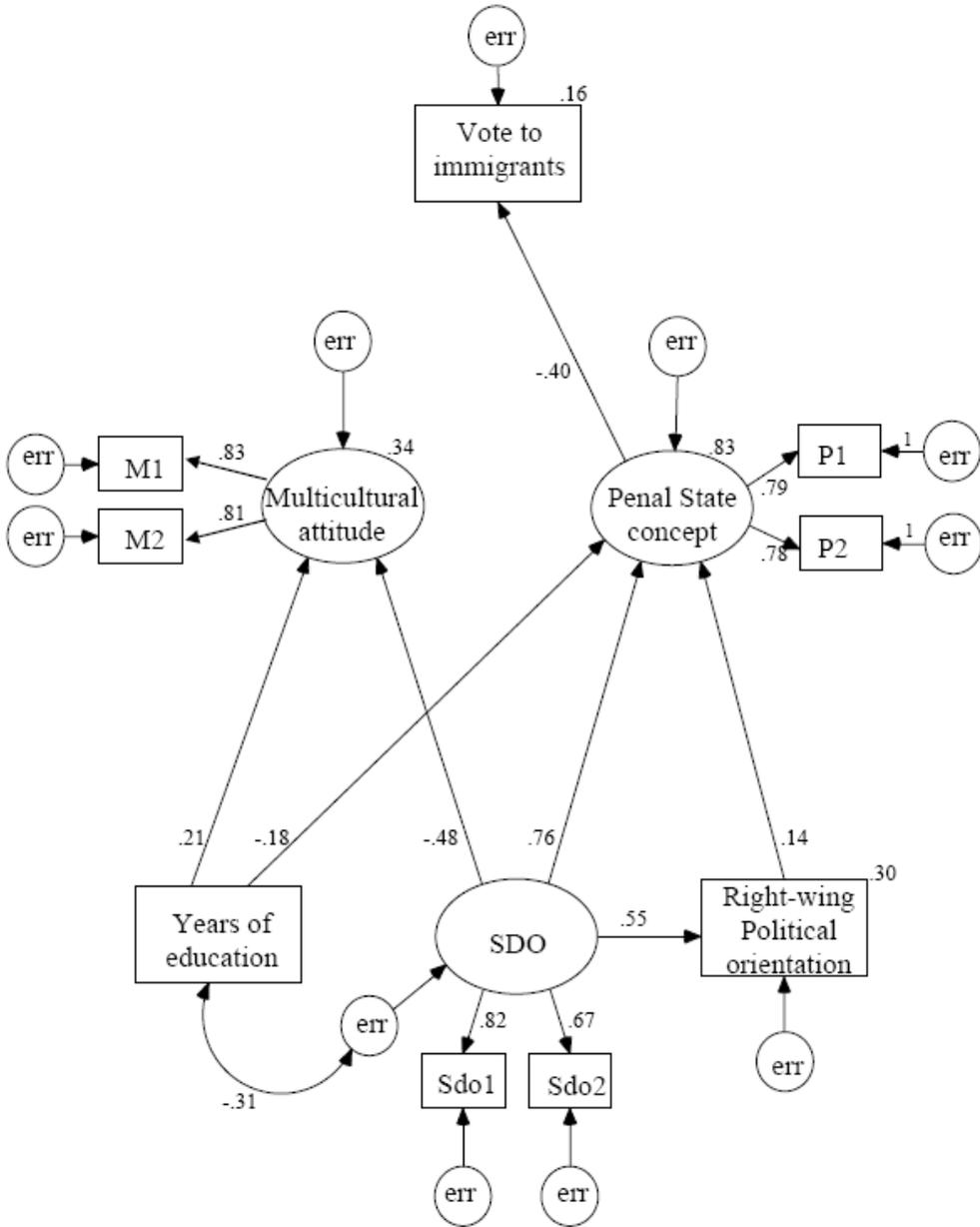


Figure 2. Structural equation model: Standardized regression weights, variances and correlations.

DISCUSSION

Contemporary processes of globalisation-localisation and the associated dynamics of increased international migration has heightened political awareness of ethnic and cultural differences within Nation-states. This complex set of phenomena explains the increasing interest that social sciences have in citizenship. However, the issue of citizenship cannot be reduced only to political and participative factors, but necessarily involves attitudes and behaviours towards inclusion and exclusion in the state, and general attitudes towards relations between groups and the social structure. These last attitudes are well represented by SDO concept (Sidanius and Pratto, 1999).

This study hypothesized that SDO affected the respondent's agreement on the immigrants right to elect their representatives. As expected, SDO was at the core of the process, generating two different but interrelated paths. In the one SDO affected the support of a Penal State; in the other SDO influenced majority members' attitudes towards multiculturalism.

We expected that both Multicultural attitude and Penal State conception would have influenced majority members' agreements to immigrants' entitlement. The results did not completely confirm this assumption. The only variable that influenced the recognition of immigrants as full ingroup members, i.e. granting them formal voting rights, was the conception of the Penal State. In these terms, a positive attitude towards cultural diversity (Multiculturalism) may imply the mere acknowledgment of the existence of cultural diversity, without any interest in involving immigrants in the host political life. In other words, cultural diversity could be seen as the positive result of mass immigration processes, but immigrant communities are not necessarily perceived as part of the ingroup, where boundaries are those of citizenship. In this frame, we can hypothesize that individuals who reject the idea of immigrants as active participants of a society life, share an "ownership" conception of the state. Following this particularistic line of thought, the state has to defend its members from the invasion of the public space of belonging (Young, 1999) and the political rights mark the diversity between to be *inside*, or to be *outside*.

Conversely, a different idea of intergroup relationships (low SDO) leads to a negative attitude towards Penal State concept and finally to the acceptance of immigrants' rights. Also in this case must the absence of a relationship between Multicultural attitudes and the immigrants' rights be considered. Here it seems that there is an universalistic concept at the basis of belonging to a citizen's ingroup, one that is more interested in the allocation of equitable resources through the enlargement of rights, than in cultural debates and critical reflection on the identities of the cultural communities now living together (Berry, 2005).

Lastly, noteworthy is the fact that political orientation was related only to the civic aspects of citizenship (Penal State concept), whereas the educational level affected both Penal State and Multicultural attitudes. This seems to suggest that the general attitude towards accepting immigrants inside the citizens' ingroup is founded on ideological and political bases, whereas the acceptance of cultural diversity implies a willingness to re-define the basic identity of the social community. In this sense, the influences exerted by the educational level could mean that the more educated individuals are the more open-minded, and do not prejudicially refuse social changes, taking into account social equality issues. This last question is suggested by the negative correlation between SDO and the educational level.

CONCLUSIONS

In this study we found a link among psychological individual variables, psychosocial attitudes and behaviours of inclusion vs. exclusion of ethnic groups that differ from one's own. The results seem to be very interesting. However, they represent a starting point for further research, that may overcome the limits of this study.

A first line of development could be the study of the relationships between the attitudes we considered in this work, and further specific behaviours that reflect different conceptions of citizenship. Indeed, this complex concept may include more than the simple agreement about the right of immigrants to elect representatives.

A second line of study could be done on the relationship between SDO and the conceptions of the State and its functions, including the annexed representations. We can, therefore, hypothesize that other attitudes apart from Penal State conception, i.e. Welfare State conception, might be relevant for this study (Sanchez-Mazas, et al., 2003).

Finally, on the basis of our results that link a psychological individual variable as SDO to the issue of citizenship, we are of the opinion that studies covering personality variables, like the Big Five and adult attachment styles, should be carried out.

REFERENCES

- Bagozzi, R.P. (1993). Assessing construct validity in personality research. Application to measures of self esteem. *Journal of Research in Personality*, 27, 49-87.
- Bagozzi, R.P., and Edwards, J.R. (1998). A general approach for representing constructs in organizational research. *Organizational Research Methods*, 1, 45-87.
- Bentler, P. M. (1990). Comparative fit indexes in structural models. *Psychological Bulletin*, 107, 238-246.
- Bentler, P. M. and Bonett, D. G. (1980). Significance tests and goodness of fit in the analysis of covariance structures. *Psychological Bulletin*, 88, 588-606.
- Berry, J. W. (2005). Acculturation: Living successfully in two cultures. *International Journal of Intercultural Relations*, 29, 697-712.
- Berry, J. W. (2006). Mutual attitudes among immigrants and ethnocultural groups in Canada. *International Journal of Intercultural Relations*, 30, 719-734.
- Bollen, K. A., and Long, J. S. (1993). *Testing Structural Equation Models*. Newbury Park, CA: Sage.
- Browne, M. W. (1990). *MUTMUM PC: User's guide*. Columbus, OH: Ohio State University, Department of Psychology.
- Campomori, F. (2008). Quando la cittadinanza diventa locale: Immigrazione e diritti sociali in Italia [When the citizenship become local: Immigration and social rights in Italy]. Unpublished manuscript.
- Clémence, A., Doise, W., De Rosa, A. S., and Gonzalez, L. (1995). La représentation sociale des droits de l'homme: Une recherche internationale sur l'étendue et les limites de l'universalité. [The social representation of the human rights: International research on the range and limits of universality]. *International Journal of Psychology*, 30, 181-212.

- Dahrendorf, R. (1988). *The Modern Social Conflict: An Essay on the Politics of Liberty*. Berkley: University of California Press.
- Devos, T., Spini, D., and Schwartz, S. H. (2002). Conflicts among human values and trust in institutions. *British Journal of Social Psychology*, 41, 481-494.
- Di Stefano, G., and Roccato, M. (2005). Una banca di item per misurare l'orientamento alla dominanza sociale in Italia. [An item bank for measuring social dominance orientation in Italy]. *TPM*, 12, 5-20.
- Diaz-Veizades, J., Widaman, K. F., Little, T. D., and Gibbs, K. W. (1995). The measurement and structure of human rights attitudes. *Journal of Social Psychology*, 135, 313-328.
- Geertz, C. (1983/2000). *Local Knowledge: Further Essays in Interpretative Anthropology*. New York: Basic Books.
- Geertz, C. (1996). Welt in Stücken: Kultur und Politik am ende des 20. Jahrhunderts. IWM, Vorlesungen zur modernen Philosophie [The world in pieces: Culture and politics at the end of the century. Lectures at the Insitut für die Wissenschaft von Menschen]. Wien/AUT: Passagen Verlag.
- Graves, T. D. (1967). Psychological acculturation in a tri-ethnic community. *South Western Journal of Anthropology*, 23, 337-350.
- Hopkins, N., Reicher, S. D., and Kahani-Hopkins, V. (2003). Citizenship, participation and identity construction: Political mobilization amongst British Muslims. *Psychologica Belgica*, 43, 33-54.
- Hu, L. and Bentler, P.M. (1998). Fit indices in covariance structure modeling: Sensitivity to underparameterized model misspecification. *Psychological Methods*, 3, 424-453.
- Martiniello, M. (1997). *Sortir des ghettos culturels* [Getting out from cultural ghettos]. Paris: Presses de Sciences Po.
- Moghaddam, F. M., and Vucksanovic, V. (1990). Attitudes and behaviour towards human rights across different contexts: The role of right-wing authoritarianism, political ideology, and religiosity. *International Journal of Psychology*, 25, 455-474.
- Pratto, F., Sidanius, J., Stallworth, L. M., and Malle, B. F. (1994). Social Dominance Orientation: A personality variable predicting social and political attitudes. *Journal of Personality and Social Psychology*, 67, 741-763.
- Pratto, F., Stallworth, L. M., and Conway-Lanz, S. (1998). Social Dominance Orientation and the ideological legitimization of social policy. *Journal of Applied Social Psychology*, 28, 1853-1875.
- Redfield, R., Linton, R., and Herskovits, M. (1936). Memorandum on the study of acculturation. *American Anthropologist*, 38, 149-152.
- Sanchez-Mazas, M., VanHumskerken, F., and Casini, A. (2003). Towards a social representational approach to citizenship: Political positioning in lay conceptions of the Belgian and of the European citizen. *Psychologica Belgica*, 43-1/2, 55-84.
- Sidanius, J. and Pratto, F. (1999). *Social Dominance*, Cambridge: Cambridge University Press.
- Spini, D. and Doise, W. (2004). Universal Rights and Duties as Normative Social Representations. In N. J. Finkel, F. M. Moghaddam (Eds.), *The Psychology of Rights and Duties: Empirical Contributions and Normative Commentaries* (pp. 21-48). Washington, DC: American Psychological Association.
- Steiger, J. H. (1980). Structural model evaluation and modification. An interval estimation approach. *Multivariate Behavioral Research*, 25, 173-180.

Tucker, L. R. and Lewis, C. (1973). A reliability coefficient for maximum likelihood factor analysis. *Psychometrika*, 38, 1-10.

Wang, Y., Davidson, M. M., Yakushko, O. F., Savoy Bielstein, H., Tan, J. A., and Bleier, J. K. (2003). The Scale of Ethnocultural Empathy: Development, validation, and reliability. *Journal of Counselling Psychology*, 50, 221-234.

Young, J. (1999). *The exclusive society*. London: Sage.

Chapter 17

SOCIAL INTERACTION EFFECT ON INTERLEAGUE PLAY ATTENDANCE: THE CASE OF THE JAPAN PROFESSIONAL BASEBALL LEAGUE

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ABSTRACT

The Japan Professional Baseball League recently began interleague play, in which the Central league teams play a game with the Pacific league teams, in order to attract fan interest. The Central League is far more popular than the Pacific League. This paper explores whether the different features of the two leagues eventually result in affecting the demand behavior of fans for interleague games. The main findings are that when compared with the PL fans, the attendance of the CL fans tends to be more inelastic with respect to team performance and competitive balance but more elastic with respect to ticket prices and the existence of substitutes. Social interaction and addictive behavior appear to account for the evidence, as stated above.

JEL classification: *L83, Z13*

Keywords: *interleague play, social interaction, demand, game attendance*

1. INTRODUCTION

Since the establishment of the Japanese Professional Baseball League (hereafter JPBL) in the mid-1930s, baseball has been the most popular professional sport in Japan for a long time. Nonetheless, an unprecedented decline in attendance and program ratings for games has been observed recently. This tendency has induced both structural and institutional changes in the JPBL. The controversy between the players' labor union and team owners concerning the

restructuring of the JPBL triggered the first ever player strike in the history of the JPBL. In the end, the player's labor union and owners reached a compromise on the condition that the labor union would cease the strike in return for deciding not to restructure the JPBL and agree to hold interleague play to attract fan interest and increase attendance¹. As a result, in the spring of 2005, the first interleague game was held in the history of the JPBL, and it was counted as a regular season game.

The JPBL consists of the Central League (hereafter CL) and the Pacific League (hereafter PL). As stated in the following section, it is widely known that, historically, the CL, including the Giants as the "leader" of the JPBL, has been far more popular with fans than the PL (La Croix and Kawaura 1999, Nomura 2006). Accordingly the games of the CL, and in particular those of the Giants, have drawn greater attendance than those of the PL. Therefore, the teams belonging to the PL have a more positive view of interleague play since they can expect that by playing against the CL teams, in particular the Giants, will attract many fans to watch their games.

The CL and PL have distinctly different features that have formed historically and persisted long after their establishment. The attendance for the interleague play games where the CL team plays against the PL team naturally consists of both CL fans and PL fans. This study takes the view that the characteristics of each league mold the behavior of the fans attending the games. According to social interaction theory (Becker and Murphy 2000), a person's demand behavior partly depends upon attitude and the conduct of other persons with whom the person often comes into contact with². The pattern of conduct of baseball fans seems to be shaped by the environment in which they become fans of baseball. Hence, the different feature of the environments of the CL and PL within a historical institution such as the JPBL seems to have a crucial impact on the progress of forming the character of fans. Consequently, the determinants of attendance to the JPBL game are likely different between the CL and PL³. That is, the features of the institution, i.e., the league, should have an important effect on attendance⁴. It is therefore crucial in the present inquiry to explore the economic phenomenon from this institutional point of view. Although the abovementioned social interaction effects seem to be applicable to sports economics, little is known about such social interaction effects upon the demand for professional sports.

Some studies have provided evidence concerning the determinants of attendance separately for the American and National Leagues in Major League Baseball (Schmidt and Berri 2001; 2003). However, they did not focus on their different characteristics or examine whether such characteristics would have an effect on the result. The empirical objective of this paper is to ascertain the determinants of game attendance in interleague play and examine

¹ The conditions under which the interleague games were held are similar to the case of the Major League (Butler, 2002). Schmidt and Berri (2004 a) and Coats and Harrison (2005) examined the influence of Major League strikes on consumer demand.

² The social interaction mechanism is useful for analyzing various human behaviors. See, for instance, Glaeser et al. (1996), Glaeser et al. (2002), and Topa (2001).

³ Economists have been interested in attendance for Major League Baseball (Butler 2002, Schmidt and Berri 2001; 2002; 2004a; 2004b, Coats and Harrison 2005). Some students pay attention to and explore the JPBL (Ohtake and Ohkusa 1994; Ohkusa and Ohtake 1996, Ohkusa 1999; 2001, La Croix and Kawaura 1999). Nevertheless, to the author's best knowledge, there is no study which focuses upon the attendance of the JPBL.

⁴ Yamamura and Shin (2008; 2009) provide the evidence that the difference between PL and CL in characteristics leads to different outcomes in the competitive balance and the development process between them.

the extent to which league characteristics affect the attendance of interleague play games. The differences in behavior between the fans of the CL and PL are interpreted mainly from the standpoint of social interaction. Following Butler (2002), the factors affecting game by game attendance are identified empirically through regression analysis using data from the interleague game of the 2005 JPBL season.

The organization of this paper is as follows. In the next section, the features of the JPBL and the results of interleague play in 2004 are surveyed. Then, the regression functions are specified and the results of the estimation are discussed. Finally a conclusion is provided.

2. REVIEW OF PROFESSIONAL BASEBALL IN JAPAN

2.1. Overview

The JPBL, inaugurated in 1936, initially comprised seven teams forming one league. Later, in 1950, the JPBL was divided into two leagues, the CL and the PL, and the two league system has continued ever since (Baseball Magazine 2004). The team achieving the highest winning percentage in each pennant race is the winning team for that respective league, become the “finalists” for the championship. At the end of the season, the “Japan Series,” in which the two winning league teams play games on behalf of their league, is held to determine the overall champion.

Since the inauguration of the JPBL, the Giants have become champion 29 times. The Giants’ 29 victories are one and a half times more than the next-placed Lions’ 19 victories, indicating that Giants have dominated the JPBL teams in terms of team performance. The Giants are the most popular team due not only to team performance during games but also to the effects of superstar, i.e., the presence of “super stars,” such as Shigeo Nagashima, who has been called “Mr. JPBL,” Sadaharu Oh, who hit a total of 868 and is known as the “Home Run King,” and more recently Hideki Matsui, who later became a regular player for the New York Yankees (Rosen 1981)⁵. Historically, the CL, including the Giants, has been viewed as the leader of the JPBL and has been far more popular with fans than the PL (La Croix and Kawaura 1999). As for average game attendance during the whole regular season in 2005, the CL recorded 26.6 thousand fans. Three of the six teams belonging to the CL, i.e., the Giants, Tigers, and Dragons, saw over 30 thousand in average attendance. On the other hand, 20.2 thousand fans attended the PL games on average, and only one of the six teams in the PL, the Hawks, saw over 30 thousand fans (Baseball Magazine 2006)⁶. This is the one of the reasons why the PL committee was much more eager to hold interleague play games, allowing PL teams to play games against the Giants.

⁵ The Giants were the first team to learn the strategy of the Major League from the Los Angeles Dodgers through the training camp in the Dodgers town in 1961 (Nomura 2006). The borrowing of advanced technology learned from the Major League by the Giants resulted in improved playing levels of the JPBL. Therefore the Giants are considered the entrepreneur, or the leader, of the JPBL. Yamamura (2009) argues that such a borrowing of technology caused the levels of the national football teams to converge.

⁶ Prior to 2005, accurate data of attendance of the JPBL was not published, and thus an examination of attendance has not correctly been conducted due to measurement errors.

Table 1. Results of Interleague Play

Pacific Team	Win	Loss	Draw	Central Team	Win	Loss	Draw
Marines	24	11	1	Tigers	21	13	2
Hawks	23	12	1	Dragons	15	21	0
Lions	18	18	0	Swallows	20	16	0
Buffaloes	17	16	3	Bay Stars	19	17	0
Fighters	12	22	2	Giants	18	14	4
Golden Eagles	11	25	0	Carp	11	25	1
Total	105	104	7	Total	104	105	7

Source: Baseball Magazine (2006).

Note: Numbers of wins, losses, and draws in the interleague play.

2.2. Result of Interleague Play

In interleague play, the CL team plays a game against the PL team. Interleague games are recorded as part of the regular season. Thus the results of interleague play are added to that of the whole regular season, thereby affecting the pennant race in each league.

The results of interleague play in 2005 are reported in Table 1. All 216 interleague games were played during the months of May and June, with Pacific teams winning 105 times, losing 104 times, and ending in a draw 7 times. These numbers indicate that the performance of the PL is competitive with that of the CL. The Giants, who, as stated above, are considered the most popular team and have the most prominent historical record in the JPBL, did not dominate in game performance in interleague play. In 2005, the average payroll of the CL was 82.1 million yen, constituting about one and half times that of the PL, which was 57.1 million yen (Japan Professional Baseball Players Association Home Page)⁷. Assuming that the average payroll represents a team's potential performance, there is distinct gap between the CL and the PL. The difference in potential league performance measured by average payroll, however, did not reflect the results of interleague play. Thus, there seems to be a difference regarding the incentive to win interleague games since the marginal effect of winning on attendance and popularity can be expected to be higher for the less popular PL league teams than for the CL teams.

Turning now to the average attendance per game, which is taken as a measure of popularity, the data for interleague play are shown in Table 2. In Panel A it can be seen that only the attendance numbers of the Giants and Tigers games are over 30 thousand, indicating that these two central teams are able to realize concentrated attendance for their games. Despite the undistinguished performance of the Giants during interleague play, as shown in Table 1, the Giants predominately attract fans to their games. This seems to be due to the influence from past popularity, namely the intertemporal linkage in demand for game attendance.

⁷ Majority of Japanese players in major league are from PL (Nomo, Ichiro, Jojima, Iguchi, Taguchi, Matsuzaka). This is partly and presumably due to the low level of payroll in PL. Put it differently, the underestimation of player's performance in PL leads to a flow of them from JPBL to US major league.

Table 2. Statistics of Attendance Per Game During Interleague Play

Panel A (in thousands)			
Pacific Team		Central Team	
Hawks	29.8	Swallows	16.6
Fighters	24.4	Carp	16.6
Eagles	20.9	Dragons	24.7
Marines	22.8	Giants	34.2
Lions	21.5	Tigers	33.6
Buffaloes	21.0	Bay Stars	14.6

Panel B (in thousands)	
Day	
Monday	14.6
Tuesday	20.5
Wednesday	22.2
Thursday	22.5
Friday	21.5
Saturday	26.8
Sunday	27.1

Source: Baseball Magazine (2006)

Becker and Murphy (1988) have developed an addictive behavior model in which past consumption stimulates current consumption by affecting the marginal utility of current and future consumption. Therefore, addictive behavior may as well reasonably account for fan demand for JPBL games.

Panel B of Table 2 shows the attendance by day of the week, which is one of the factors expected to influence attendance (Butler 2002). Attendance numbers for Saturday and Sunday are obviously larger than for rest of the week, which is consistent with our intuition that on holidays fans are more easily able to find spare time to enjoy the JPBL.

2.3. Feature of the CL and PL

Showing a comparison of the characteristics of each team's host prefecture and stadium between the CL and PL leagues, Table 3 provides descriptive statistics separately for the CL and PL. The average per capita incomes of the team host prefectures are 5.23 million yen for the CL home and 4.24 million yen for the PL home. Moreover, the populations of the CL home are roughly four times larger than those of the PL suggesting, that the CL home areas are located in more urbanized areas.

Consumer demand for JPBL game tickets is likely to be diverse, presumably since consumer behavior depends upon various factors, such as income, age, gender, status, and family size. Given that this is true, the more diverse kinds of tickets are made available for purchase, then the greater numbers of tickets will be sold. Actually, most stadiums currently offer various kinds of seats. For example, the outfield bleacher and infield bleacher seats are further divided into various ranks, such as free, reserved, and special seats.

Table 3. Descriptive Statistics

	Central home	Pacific home	All
Per capita income of prefecture where teams host prefecture (in million yen)	5.23	4.24	4.73
Population of team's prefecture (in millions)	5.56	1.24	3.35
Average price of the ticket in team's host stadium (in yen)	2,168	2,140	2,150
Number of kinds of tickets in team's host stadium	7.67	8.75	8.22
Coefficient of variation of the ticket price among kinds of tickets in team's host stadium	0.69	0.76	0.73
Seating capacity of the team's host stadium	42,568	38,562	40,517
Number of professional football teams located in team's host prefecture	2.04	1.42	1.72

Source: <http://www.j-league.or.jp/>, Takarajima (2005)

Note: Average Price Of The Ticket Is The Simple Average Of The Various Ticket Prices.

Table 3 shows that the simple average ticket prices are 2168 in the CL and 2140 in the PL⁸. The average numbers of kinds of tickets in each team's host stadium are 7.67 in the CL and 8.75 in the PL. Next, concerning their coefficients of variation, the PL has a larger value. This implies that managers of the PL teams make more efforts to lower ticket prices and diversify the seating options. As described earlier, the CL is more popular with fans than the PL because the CL teams play games with the Giants, who are considered the "leader" of the JPBL. It seems inevitable that the CL teams depend upon the Giants to generate attendance and that the existence of the Giants reduces the incentive to improve services for fans. For example, the more popular a team is, then the larger the seating capacity of the team's host stadium must be. The average seating capacity of each team's host stadium in the CL is larger than that of the PL, and this supports the argument of the CL's superiority over the PL concerning popularity.

The Japanese Professional Football League (hereafter JPFL), which is regarded as a substitute for the JPBL, was inaugurated in 1993 and provided competitive pressure to the JPBL in the professional sports market. In Table 3 it can be seen that the average numbers of JPFL teams located in the prefectures of host stadiums are 2.04 for the CL and 1.42 for the PL, indicating that the JPFL teams are more likely to be located in more urbanized areas where the CL teams tend to be located, as stated above. As a result, the CL teams must compete with the JPFL for attracting attendance.

⁸ Ticket prices were calculated by weighted average for various seats (Schmidt and Berri 2001). Due to the lack of data for calculating the weighted average, the simple averages of the various kinds of seats are used in this paper.

3. MODEL AND ESTIMATION

3.1. Regression Function

This section specifies the regression function used to ascertain the determinants of the attendance of individual games during interleague play in 2005.

Following Schmidt and Berri (2001) and Coates and Harrison (2005), determinants of a demand function for baseball game attendance would generally be current team performance taken as team quality, income, and size of market, in addition to competitive balance. Additionally, the day of the week on which games are played, as described in Butler (2002), and available substitute spectator sports would be also expected to influence attendance.

Some fans are interested in the pennant race of the regular season as a whole. Other fans, on the other hand, are fascinated partly by interleague play, which can be considered an even greater milestone in the history of the JPBL than the pennant race. Accordingly, as a proxy for current team performance, this study used not only current team winning ratios during interleague play but also current team winning ratios during the regular season in order to better capture fan interest in team quality. Moreover, for each game of interleague play the CL team was matched up against the PL team, and thus the attendance was comprised of both PL and CL team fans. Attendance by the CL fans was thus affected by the current the CL team performance, whereas that by the PL fans was affected by the current the PL fans⁹. As a consequence, each current winning ratio stated above for the CL and the PL teams was included in the regression function. It was expected that high team quality would increase the attendance and that therefore the signs of its coefficients would be positive.

A common proxy for the size of a game's market is the size of the area where the team host stadium is located in addition to the size of the stadium itself. In this study, per capita income and the population of the prefecture where the game was played were used to capture the size of the game's market. These data were obtained from *Minryoku* (Asahi Shinbunsha, various years). A large market size would result in increasing attendance. Consequently, the signs of the market size coefficients were expected to be positive.

The ticket price, numbers of tickets, and coefficients of variation of ticket price, as earlier described, were included. If the diversification of tickets extends the market by luring various consumers consisting of not only enthusiastic fans but also latent ones, then the coefficients on the numbers of ticket and the coefficients of variations of ticket price would be positive. In addition to these variables related to the tickets, the average ticket price was included as a variable for interaction with the CL home game dummy, which took a value of 1 if the CL team played at home and a value of 0 otherwise, in order to account for differences of the effect of ticket price on attendance between the CL and PL.

With the objective of capturing the popularity of the CL, the CL team home game dummy was used. Following the previous discussion, coefficients on these variables were expected to be positive. The regressions were also controlled for weekends effects by including a Sunday dummy and Saturday dummy, which are equal to 1 for each day of the

⁹ Although fans are also interested in opponent performance, of which the players belong to the other league, they are likely to pay much more attention to that of their favorite team.

week. They were expected to be positive since fans have more time to enjoy games on holidays than on weekdays.

As described previously, the inauguration of the JPFL was regarded as a substitute for baseball, and therefore it seems to have played a critical role in the decline in popularity of the JPBL¹⁰. Indeed, a portion of the JPBL fans seems to have switched over to attending more games of the JPFL. The Japan-Korea World Cup accelerated the shift in popularity from the JPBL to the JPFL. This factor has therefore been taken into account with respect to the effect of the emergence of the JPFL. Accordingly data of the professional football teams in the respective prefectures were incorporated into the regression function in order to capture such substitute effects. The predicted signs of its coefficients were convincingly negative.

Economists have been interested in whether the competitive balance has an effect upon league outcomes (e.g., El-Hodiri and Quirk 1971; Schmidt and Berri 2001). If the fans of a league were competitively imbalanced, one might expect a decline in attendance. In other words, the uncertainty of outcomes in the pennant race would lead to an increase in fans interest, thereby increasing attendance. Following previous research (Knowles, Sherony, and Houpert 1992, Schmidt and Berri 2001), it can be predicted that an increase in a league's competitive balance would have a positive influence on game attendance. With the objective of accounting for competitive balance being the distribution of wins within each league, the regression therefore includes its proxy, which in this inquiry was measured by the standard deviation of the current number of regular season wins. The large value of this regression can be interpreted as competitive imbalance. Its coefficient, therefore, can be expected to be negative.

¹⁰ Lee (2006) suggests that the emergence of Major League Baseball as a rival league to the Korean Professional Baseball League in Korea accounted for more than half of the decline in attendance that occurred between 1995 and 2000. The superstars of the JPBL, for instance Nomo, Ichiro, Matsui, and Jojima, left the JPBL and became Major Leaguers, and as a result fans became more interested in their play in the Major League. Therefore, Major League Baseball is also considered as a substitute for the JPBL. One future direction of this research is to take such major league effects into account.

Table 4. Attendance Regression Results

	(1)	(2)	(3)	(4)	(5)	(6)
Regular season winning ratio for Pacific team		0.32** (4.21)	0.28** (3.23)		0.32** (4.72)	0.34** (4.10)
Interleague winning ratio for Pacific team	0.13** (2.64)		0.03 (0.62)	0.09* (1.82)		-0.03 (-0.54)
Regular season winning ratio for Central team		0.15 (0.97)	0.14 (0.83)		0.19 (1.32)	0.22 (1.42)
Interleague winning ratio for Central team	0.009 (0.16)		-0.02 (-0.45)	0.01 (0.30)		-0.03 (-0.61)
Per capita income of prefecture where game was held	-0.38** (-7.54)	-0.38** (-7.56)	-0.38** (-7.37)	-0.54** (-8.32)	-0.55** (-9.27)	-0.55** (-9.23)
Population of prefecture where game was held	-0.02 (-1.02)	-0.009 (-0.42)	-0.01 (-0.56)	0.23** (4.36)	0.26** (5.19)	0.26** (5.10)
Seating capacity of the stadium	0.83** (7.45)	0.78** (6.88)	0.82** (7.05)	0.58** (4.57)	0.55** (4.55)	0.54** (4.09)
Average price of the ticket	0.13 (1.18)	-0.01 (-0.11)	0.01 (0.09)	0.10 (1.00)	-0.05 (-0.52)	-0.03 (-0.29)
Average price of ticket *Central team home game dummy				-1.21** (-5.35)	-1.31** (-5.99)	-1.32** (-5.86)
Number of kinds of tickets in stadium where game was held	0.11 (1.39)	0.02 (0.24)	0.05 (0.61)	0.03 (0.47)	-0.03 (-0.37)	0.05 (0.61)
Coefficient of variation of the ticket price among kinds of tickets	0.88** (6.78)	0.97** (6.84)	0.93** (5.84)	1.42** (7.68)	1.52** (8.99)	1.50** (8.12)
Central team home game dummy	0.21** (10.4)	0.20** (10.8)	0.20** (9.80)	1.33** (6.31)	1.42** (6.90)	1.43** (6.70)
Saturday dummy	0.03** (5.25)	0.03** (5.69)	0.03** (5.64)	0.03** (5.35)	0.03** (5.94)	0.03** (5.97)

Table 4. (Continued).

	(1)	(2)	(3)	(4)	(5)	(6)
Sunday dummy	0.03**	0.03**	0.03**	0.03**	0.03**	0.03**
	(4.40)	(4.70)	(4.66)	(4.51)	(4.92)	(4.92)
Numbers of professional football team in prefecture where game is held	-0.15**	-0.16**	-0.15**	-0.02	-0.004	-0.004
	(-6.00)	(-6.33)	(-5.73)	(-0.74)	(-0.15)	(-0.15)
Competitive balance of Pacific League	-0.41*	-0.36*	-0.37*	-0.42*	-0.36*	-0.36*
	(-1.91)	(-1.66)	(-1.72)	(-2.10)	(-1.89)	(-1.96)
Competitive balance of Pacific League	-0.10	-0.08	-0.09	-0.09	-0.08	-0.07
	(-1.16)	(-0.99)	(-1.13)	(-1.07)	(-1.01)	(-0.99)
Adjusted R ²	0.84	0.85	0.85	0.86	0.87	0.87
Sample	209	209	209	209	209	209

NOTE: Numbers in parentheses are t-statistics. * and ** indicate significance at the 5 and 1 percent levels, respectively (one-sided tests). Although not reported, constant, popular team dummies (Giants, Tigers, and Hawks) are included in the regressions in order to save space. If the game is held in the stadium which does not belong to the franchise of one of the professional baseball teams, we exclude it from the sample. This is why although interleague play games total 216, we use only 209 samples in the estimations above.

3.2. Estimation Results

Turning now the estimation results of the regression function as introduced above¹⁹, Table 4 shows the regression results regarding the determinants of attendance during interleague play using a simple OLS model²⁰. The values of the coefficients of all variables represent the elasticity calculated by the delta method. First, with respect to the the team performances, the signs of the coefficients for the regular season winning ratio and interleague winning ratio for the PL team are generally positive and statistically significant, being as a whole consistent with the study's expectations. The signs of the corresponding coefficients for the CL are also positive, but they are statistically insignificant. These results indicated that team performance has a positive influence upon only the attendance of the PL fans.

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According to social interaction theory (Becker and Murphy 2000), the conduct of individuals depends upon not only their own preferences but also other persons with whom they are often in contact, such as friends, colleagues, and neighbors. Thus, what others consume can stimulate a person's demand for the same things. That is to say, the more popular the goods, the more people will want them. The estimations for the CL home game dummy strongly support the presumption that the CL is more popular than the PL, implying that people are more likely to make contact with the CL fans than the PL fans. Another explanation for this result comes from the perspective of addictive behavior (Becker and Murphy 1988). If past attendance for the CL is distinctly larger than the PL, then that attendance will stimulate the demand of the CL fans for the current interleague game more

¹⁹ If the game is held in a stadium which is not part of the franchise of professional baseball teams, we excluded it from the sample. In other words, some games played at a neutral site so that these samples are not included. This is because the CL home game dummy variable could not be included when the stadium was not a franchise of the CL and PL teams. Therefore, 209 samples were used for our regression analysis though the total played games were 216 during interleague play. However, the estimation results are unchanged when all samples are used omitting the CL home game dummy variable.

²⁰ To control for the heteroscedasticity, white robust estimators are used as standard errors to calculate t-values.

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than that of the PL fans through addictive behavior, regardless of the current performance²³. Therefore an interactive as well as addictive mechanism is more likely to be seen in the CL than in the PL. If the conduct of fans depends mainly upon other fans regardless of team performance, then the above result can be explained.

As for the market size, with respect to per capita income of the respective team prefectures, its coefficients are negative and statistically significant at the 1 % level. This implies that baseball games constitute inferior goods. When the JPBL was the most popular professional sports league, it might have been normal goods, but it is the current study's view that during the process of rapid economic development in Japan, the positive features of baseball changed to inferior features. The coefficients of prefecture population, shown in columns (4), (5), and (6), and the estimated seating capacities of the stadiums were positive and statistically significant at the 1 % level. These results were in accord with this study's expectations.

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Regarding the variables related to tickets, the signs of the coefficients for the average ticket price were unstable and statistically insignificant. As stated earlier, the differences in the features that fans are faced with between the CL and the PL resulted in differences in fan conduct. From this, it can be predicted that the majority of fans are interested in the CL team

²³ The dynamic panel analysis, as conducted in Becker et al. (1994), is required to examine the effect of addictive behavior more precisely.

²⁴ The dynamic panel analysis, as conducted in Becker et al. (1994), is required to examine the effect of addictive behavior more precisely.

when the game is held in the CL team's host stadium. In columns (4) to (6), the differences of the price effect on attendance between the CL and the PL is examined by incorporating the price interaction with the CL home game dummy. Its coefficients are negative while being statistically significant at the 1 % level, suggesting that the price effect for the CL fans is stronger than for the PL fans. As mentioned earlier, it is presumed that the behavior of the surrounding people has a greater impact on CL fans than on PL ones. The CL fans are less interested in the JPBL games themselves. On the other hand, the social interaction effect on the PL attendance is fainter since there is lower probability for latent fans to interact with the PL fans. Hence, motivation for attending games is likely to be stronger for the PL fans. Moreover, if seeing a JPBL game is a necessity for PL fans, then the demand is not elastic with regard to price²⁵. In the case of the CL, however, the effect of price outweighs that of social interaction, causing demand to become elastic with regard to price for the CL fans. Another possible explanation for these results comes from the perspective of addictive behavior, given that the past attendance of the CL is larger than that of the PL. Besides, assuming that the price difference among stadiums persists over time, and that the long-run responses exceed short-run responses to price changes via addictive behavior, as suggested in Becker et al. (1994), then the price effect on the CL fan attendance is larger than that on the attendance of PL fans. This conclusion is consistent with the results above.

Although the results of estimating the numbers of the kinds of available tickets were almost positive but not statistically significant, in the results of the coefficient of variation all estimations produced a positive sign and were statistically significant at the 1 % level. These results are in line with our prediction concerning the impact of diversification on demand²⁶.

As expected, the coefficients on the Saturday and Sunday dummies were positive and statistically significant²⁷.

With respect to the existence of the JPFL teams considered as substitute spectator sports, it can be seen in columns (1), (2), and (3) that the coefficient is negative and statistically significant at the 1 % level. However in (4), (5), and (6) the coefficient is negative despite being insignificant. The prominent decrease in t values arises when the price of tickets interacting with the CL home dummy is included. This evidence suggests that demand shifted from the JPBL to the JPFL is also equivalent to a decline in demand by the CL fans due to a rise in price. As shown in Table 3, the home stadiums of central teams tend to be located in urban areas where a larger number of JPFL home teams are also located. Hence, the CL teams are more likely to compete with the JPFL teams to lure more fans for greater attendance.

Looking finally at competitive balance, in all estimations the coefficients take the predicted signs, though the absolute values of the PL are roughly four times larger than those of the CL. Furthermore, those of the PL are statistically significant, while those of the CL are

²⁵ Coates and Harrison (2005) also reported that demand for baseball attendance is price inelastic.

²⁶ As shown in Table 3, the average number of the kinds of tickets is about 8 among the JPBL. The Golden Eagles, a new comer to the JPBL in 2005, differentiates seating and provides 14 different types, which is a remarkably larger number than other teams. The owner of the Golden Eagles created such diversification of tickets in order to attract greater attendance.

²⁷ Although not reported in Table 4, dummies of some popular teams such as the Giants and Tigers of the CL, and the Hawks of the PL, are included in the estimations in order to save space. As predicted, the coefficients of these variables take positive signs and are statistically significant.

insignificant. These results provide evidence that PL fans prefer parity much more than CL fans.

To sum up the evidence shown above, compared to PL fans, demand as measured by attendance of CL fans tends to be more inelastic with respect to team performance and competitive balance while being, on the other hand, more elastic with price and the existence of a substitute spectator sport. The difference of propensities between the CL and the PL might be induced by the environmental differences fans face via the social interaction among fans or the addictive behavior dependent upon past popularity. It is important to take the specific features of each institution, i.e., the CL and the PL, into consideration when attempting to ascertain the determinants of attendance²⁸. In addition, as described in the previous section, although the payroll of the PL is lower than that of the CL, the results suggest that the number of PL team wins is almost equal to that of the CL, indicating that the incentive of the PL teams to win is higher than that of the CL. The ticket prices of the PL are more varied than those of the CL, suggesting that the PL owners make more efforts to entertain their fans. The reason why the efforts of the players as well as the owners of the PL are stronger than those of the CL is that the PL fans are more elastic with respect to the quality of the game and the service due to the lack of social interaction and addiction.

4. CONCLUSION

The purpose of this inquiry was to investigate the determinants of attendance during interleague play, which is considered a milestone in the history of the JPBL. To put it more precisely, this study attempted to examine whether the different features of the CL and the PL eventually result in affecting the demand behavior for games via social interaction. Compared with the existing literature, our innovation lies in finding out the remarkable differences in fan behavior between the two leagues.

The main findings of this study are as follows. Compared with the PL fans, demand as measured by attendance of the CL fans tends to be more inelastic with respect to team performance and competitive balance. On the other hand, it tends to be more elastic with respect to price and the existence of a substitute spectator sport. To put it differently, the behavior of fans is affected by the institutional differences of the league which have historically evolved. The different features of each league have a crucial impact on the outcomes of their respective economic activities. It is critical to take the institutional view into account when analyzing the issues of sports economics²⁹. In addition to the findings described above, fans responded positively to the differentiation of tickets, thereby increasing attendance. Accordingly, strategies to diversify seating can be considered useful in restoring flagging interest in the game.

²⁸ Schmidt and Berri (2001) examined the determinants of attendance separately for the American League and the National League using both time series and panel analysis. Nevertheless, with the exception of the population's impact in the panel analysis, a distinctive difference of estimation results was not observed between the American League and National League.

²⁹ Schmidt and Berri (2004 b), La croix and Kawaura (1997), and Lee and Fort (2003) analyzed the impact of institutional change on competitive balance.

Social interaction and addictive behavior appear to account for the evidence, as stated above. However, a theoretical model is not proposed in the present paper as the explanations of the evidence are intuitive rather than logical. Thus, it will be necessary in future studies to investigate precisely the reason why demand for PL attendance was found to be more price inelastic than that for the CL. For instance, if the preferences of the fan are different between two leagues, the compensation systems for the players should be different. The wage elasticity to competitiveness for Players in PL should be larger than that for players in CL. Hence, what should be needed is to examine the difference of the compensation systems. What is more, the regression approach used in this study is very preliminary. Further directions of this inquiry should include the laying out of a simple theoretical model and a closer look at the effect of social interaction on attendance.

REFERENCES

- Asahi Shinbunsha., various years. Minryoku: TODOFUKEN-BETSU MINRYOKU SOKUTEI SHIRYOSHU. Asahi-Shinbunsha, Tokyo.
- Baseball Magazine.,2006. 2006 Baseball record book, [in Japanese]. Tokyo: Baseball Magazine-sha
- Becker, G., Murphy, K., 1988. A theory of Rational Addiction. *Journal of Political Economy* 96, 675-700.
- Becker, G., Murphy, K., 2000. *Social Economics: Market Behavior in a Social Environment*, The Belknap Press of Harvard University Press.
- Becker, G., Grossman, M., Murphy, K., 1994. An Empirical Analysis of Cigarette Addiction. *American Economic Review* 84, 396-418.
- Butler, M. R., 2002. Interleague play and baseball attendance. *Journal of Sports Economics* 3, 320-334.
- Coates, D., Harrison, T., 2005. Baseball strikes and the demand for attendance. *Journal of Sports Economics* 6, 282-302.
- El-Hodiri, M., Quirk, J., 1971. The economic theory of a professional sports league, *Journal of Political Economy* 79, 1302-1319.
- Glaeser, E. L, Sacerdote.B.I., Scheinkman. J. A., 1996. Crime and Social Interaction. *Quarterly Journal of Economics* 111, 505-548.
- Glaeser, E. L, Sacerdote, B.I., Scheinkman, J. A., 2003. Social Multiplier. *Journal of the European Economic Association* 1, 345-353.
- Japan Professional Baseball Players Association Home Page. Research and Report, http://jpbpa.net/jpbpa_f.htm?report/index.htm.
- Knowles, G., Sherony, K., Hauptert, M., 1992. The demand for major league baseball: A test of the uncertainty of outcome hypothesis. *American Economist* 36, 72-80.
- La Croex, S, J., Kawaura, A., 1999. Rule changes and competitive balance in Japanese professional baseball. *Economic Inquiry* 37, 353-368.
- Lee, Y, H., 2006. The Decline of Attendance in the Korean Professional Baseball League: The Major League Effects. *Journal of Sports Economics* 7, 187-200.
- Lee, Y, H., Fort, R., 2003. Structural change in MLB competitive balance: the depression, team location, and integration. *Economic Inquiry* 43, 158-169.

- Nomura, K., 2006., *Kyojin-gun Ron: Soshiki Towa, Ningen Towa, Dentoh Towa*. [in Japanese](The Giants: the organization, a human, the tradition), Tokyo: Kadokawa-shoten.
- Ohkusa, Y., 1999. Additional evidence for the career concern hypothesis with uncertainty of the retirement period: The case of professional baseball players in Japan. *Applied Economics* 31, 1481-1487.
- Ohkusa, Y., 2001. An empirical examination of the quit behavior of professional baseball players in Japan. *Journal of Sports Economics* 2, 80-88.
- Ohkusa, Y., Ohtake, F., 1996. The relationship between supervisor and workers: The case of professional baseball in Japan. *Japan and the World Economy*, 8, 475-488.
- Ohtake, F., Ohkusa, Y., 1994. Testing the matching hypothesis: The case of professional baseball in Japan with comparisons to the United States. *Journal of the Japanese and International Economies*, 8, 204-219.
- Rosen, S., 1981. The economics of superstars. *American Economic Review* 71, 845-858.
- Schmidt, M. B., Berri, D.J., 2001. Competitive balance and attendance: The case of major league baseball. *Journal of Spots Economics* 2, 145-167.
- Schmidt, M. B., Berri, D.J., 2002. The impact of the 1981 and 1994-1995 strikes on major league baseball attendance: a time series analysis. *Applied Economics* 34, 471-478.
- Schmidet, M. B., Berri, D.J., 2004 a. The impact of strikes on consumer demand: An application to professional sports. *American Economic Review* 94, 344-455.
- Schmidet, M. B., Berri, D.J., 2004 b. Convergence and clustering in Major league baseball: the have and have nots?. *Applied Economics* 36, 2007-2014.
- Takarajima., 2005. 2006 Professional Baseball Perfect Data: The Directory of Baseball Players 2005, [in Japanese]. Tokyo: Takarajima-sha
- Topa,G., 2001. Social Interactions, Local Spillovers and Unemployment. *Review of Economic Studies* 68, 261-295.
- Winfree, J.A, McCluskey, J.J, Mittelhammer, R.C, Fort, R., 2004. Location and Attendance in Major League Baseball. *Applied Economics* 36, 2117-2124.
- Yamamura, E., 2009. Technology Transfer and Convergence of Performance: an economic study of FIFA football ranking. *Applied Economics Letters* 16(3), 261-266.
- Yamamura, E. and Shin, I., 2008. The Influence of a Leader and the Social Interaction on Attendance: The Case of the Japanese Professional Baseball League, 1952-2003. *Journal of Socio-Economics*,37(4), 1412-1426.
- Yamamura, E. and Shin, I., 2009. Convergence, clustering and their effects on attendance in the Japan Professional Baseball League.. Forthcoming in *Applied Economics*.

Chapter 18

IS SHE HOT OR NOT? THE IMPACT OF GENDER AND ALCOHOL ON SOCIAL COMPARISONS OF ATTRACTIVENESS AND PROMISCUITY

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ABSTRACT

We explored the impact gender, alcoholic drink type, and amount drank had on perceptions of sexual intent. An experiment was conducted in which participants watched a video of a female target and her date socializing at an after-finals party. The type of alcoholic drink (beer or margarita-flavored alcopop) and amount drank (two or six drinks) was fully crossed. As hypothesized, men rated the female target in more sexual terms than did women. In addition, alcohol cues impacted perceptions of the female target as women rated the female target as more promiscuous when she drank six margarita-flavored alcopops versus two.

Keywords: *Sexual Intent, Alcohol, Downward Social Comparison*

Imagine for a moment, two friends – a male and female undergraduate – leaving a classroom after completing their final exam. Upon exiting the classroom, they begin talking about how difficult the final exam was and how happy they are that the semester is over. Before going their separate ways, the male asks the female if she would like to go with him to an after-finals party not far from campus this weekend. Further, imagine that it is Saturday

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night, and our couple has arrived at the party. As they make their way to the kitchen to get something to drink, they encounter other students alleviating the stress of the semester by talking with friends, playing various card and board games, and drinking. For our couple, the moment of truth has arrived as they stand in the kitchen gazing into the refrigerator – what should each have to drink? Beer, liquor, or a non-alcoholic beverage?

HOW DOES BEVERAGE CHOICE IMPACT PERCEPTIONS OF SEXUALITY?

George and his colleagues (George, Cue, Lopez, Crowe and Norris, 1995; George, Gournic and McAfee, 1988) found that a female who consumed an alcoholic beverage was perceived to be less socially skilled and more sexually promiscuous compared to a female who consumed a non-alcoholic beverage. Thus, it appears women who consume large amounts alcohol have their virtue and reputation questioned (Room, 1996). Additional studies (Abbey, Zawacki and Buck, 2005; Abbey, Zawacki, and McAuslan, 2000; Abbey and Harnish, 1995; Abbey, 1991) indicate that when both a male and female target drank alcohol they were perceived in more sexual terms compared to when only one of the targets drank alcohol or when both targets did not drink alcohol. Indeed, surveys among Americans examining drinking and sexual behavior further support the notion that alcohol and sexuality is strongly linked. These surveys revealed that Americans believe alcohol increases the likelihood of engaging in sexual activity, enhances sexual experiences, and promotes risky sexual behavior (Cooper, 2002; Leigh and Stall, 1993).

HOW DOES ALCOHOLIC BEVERAGE CHOICE AFFECT PERCEPTIONS OF INTOXICATION?

George, Gournic and McAfee (1988) found that both males and females perceived a target as being more intoxicated when drinking whiskey than wine or beer. Interestingly, there was no difference in perceived intoxication of the target when the target drank wine or beer despite the different alcohol content of each. Wine has an alcohol content of around 10 to 14 percent, while beer generally has an alcohol content of around four to six percent. “Hard” liquors, like whiskey, can have alcohol content anywhere from 40 to 70 percent (World Health Organization, 1999).

Little research has been conducted examining the most rapidly growing segment of alcoholic beverages and its impact of perceptions of intoxication. In 1996, *The Grocer*, a British food and drink trade publication, coined the term, “alcopop” to describe alcoholic soft drinks. Alcopops are characterized by their sweet taste and can have an alcoholic content up to 5.5% which is similar to the alcoholic content in beer (Roberts, Blakey, Tudor-Smith, 1999). Research conducted among teens in the United Kingdom suggests alcopops are perceived as “more refreshing, better tasting, less likely to taste of alcohol, trendier, and suitable for teenage girls” (Health Education Authority, 1996). Indeed, when wine coolers (a type of alcopop) were introduced in America, young people and women who were not consumers of alcoholic beverages were identified as the target market (Peterson, Nisenholz,

and Robinson, 2003). Given the sweet taste of alcopops, perceptions of alcopops, and the target marketing of alcopops to novice drinkers, it might be the case that consumers of such beverages are viewed as being easily intoxicated by modest amounts of alcohol.

HOW DOES THE AMOUNT OF ALCOHOL DRANK AFFECT PERCEPTIONS OF SEXUALITY?

Because of changing norms, research is less clear about how the amount of alcohol consumed impacts perceptions of sexuality. Moderate amounts of alcohol consumption have been shown to be associated with higher ratings of sexuality compared to higher amounts of alcohol consumption (George, Gournic and McAfee, 1988). However, more recent research with undergraduate males and females suggest the opposite. For males, the ability to drink large amounts of alcohol is seen as a badge of honor and used to convince others of one's masculinity; but, there is growing pressure for women to be able to drink large quantities of alcohol as well. It seems that being able to "drink like a guy" does not question a women's heterosexuality but rather, increases it. That is, women who were able to drink large quantities of alcohol were said to be more sexually appealing to men compared to women who could not "hold their liquor" (Young, Morales, McCabe, Boyd, and D'Arcy, 2005).

The research findings of Young et al. (2005) and George et al. (1988) suggest some interesting implications for how males and females might perceive the sexuality of others when consuming alcohol. Males might perceive a female's sexuality in a more positive light when drinking alcohol. That is, males might rate the female as being more attractive than females consistent with Young et al.'s (2005) findings. Females, on the other hand, might rate a female's sexuality in a more negative light when drinking alcohol. That is, females might rate the female as being more promiscuous than males consistent with George et al.'s (1988) findings.

Our goals were to explore the impact gender, beverage type and amount has on perceptions of sexuality. More specifically, we wanted to understand how males and females would perceive a female target¹ when the target consumed beer or a margarita-flavored alcopop and had two or six drinks. Based on the reviewed literature, we formed the following hypotheses:

1. Consistent with the work of Abbey and her colleagues (e.g., Abbey et al., 2005, 2000), we hypothesized that men would perceive a female target in more sexual terms compared to women. That is, men would rate a female target as being more attractive and promiscuous than would females.
2. Because the amount of alcohol consumed impacts perceptions of sexuality (Young et al., 2005; George et al., 1988), we predicted that men, compared to women, would perceive a female target as more attractive when she drank six versus two alcoholic drinks. In contrast, we posited that women, compared to men, would perceive a female target as more promiscuous when she drank six versus two alcoholic drinks.
3. We also hypothesized that the type of alcoholic beverage a female target consumed would have an impact on perceptions of her sexuality. This is because the margarita-flavored alcopop may be perceived as more suitable for a teenage girl (Health

Education Authority, 1996) as compared to beer. This finding suggests that alcopop is more appropriate for a novice drinker, while beer is more appropriate for an experienced drinker. Thus, we predicted that women, compared to men, would perceive a female target as being more attractive when she consumed alcopop compared beer. In contrast, we hypothesized that men, compared to women, would perceive a female target as being more attractive when she consumed beer compared to alcopop.

4. Finally, we hypothesized that women would perceive the female target as more promiscuous and less attractive when the female target drank six margarita-flavored alcopops as compared to when she drank two margarita-flavored alcopops consistent with Young et al.'s (2005) and George et al.'s (1988) findings.

METHOD

Participants. Participants were 94 (47 women and 47 men) Pennsylvania State University at New Kensington undergraduate students who were randomly assigned to a 2 (Gender of Participant) x 2 (Type of Alcoholic Beverage Female Target Consumed: Beer, Margarita-flavored Alcopop) x 2 (Amount Female Target Consumed: Two, Six) factorial design. Students were enrolled in introductory psychology and received extra credit for their participation. Participants were not asked to provide any demographic information, except gender, because we had no hypotheses regarding these variables. At this campus, approximately 97% are Caucasian, and 3% are of another ethnic group. Approximately 70% of the students are between the ages of 18 and 21. All participants indicated that they were heterosexuals.

Stimulus Materials. Four videos were developed. Each video involved a young man and woman leaving a classroom after their final exam. In the hall, they discussed how difficult the exam was and how happy they were that the semester was over. Before going their separate ways, the male asked the female if she would go with him to an after-finals party this weekend being thrown by a mutual friend. The party took place at a mutual friend's apartment. In all versions of the video, the male greeted the female at the party and asked what she would like to drink as they walk into the apartment's kitchen. In two versions of the video, the female target responded, "one of those margarita coolers," while in the other two she responded, "a beer." The video concluded with the text, "Lisa and Mark talked into the night. After Lisa had her second (beer/margarita)/sixth (beer/margarita), they left the party." Thus, four videos were created: female target drinks two beers, female target drinks two margarita-flavored alcopops, female target drinks six beers, and female target drinks six margarita-flavored alcopops. We did not focus on a male target in the video manipulating what he had to drink or how much he drank because prior research (Abbey et al., 2000, 1995, 1991; George et al., 1995, 1988) suggested that it was more socially acceptable for a male to consume alcohol in the presence of a female.

Measures. The questionnaire designed to assess perceptions of the female target was modeled after Abbey (1982). Participants were asked to rate the female target on 50 different traits using a 7-point Likert-type scale with response options which ranged from not at all to very much. The order in which the trait adjectives were presented was randomized. The traits

which measured the target's attractiveness were: attractive, sexy, smooth, and suave. The attractiveness traits were combined to form an attractiveness index. Cronbach coefficient alpha for the attractiveness index was .78. Another set of items reflected the target's promiscuity: promiscuous, seductive, flirtatious, aggressive, obnoxious and snobbish. The promiscuity traits were combined to form a promiscuity index. Cronbach coefficient alpha for the promiscuity index was .70.

Behavioral intention measures. After participants rated the female target on the trait adjectives, they were asked to indicate the likelihood that the female target would have sexual intercourse with her date later that evening. This item was rated on a 7-point Likert-type scale where response options ranged from not at all likely to very likely.

Ratings of Intoxication. Participants were also asked to indicate what the female target had to drink, how much she consumed, and the degree to which the female target was drunk. The latter item was rated on a 7-point Likert-type scale where response options ranged from not at all to very much.

Apparatus. The experiment was administered via Dell Dimension 4100 personal computers running MediaLab software (2004). The video depicting the couple's interaction was presented in the center of the computer screen. The video display dimension was 5.7 centimeters x 9.5 centimeters. The closing text which delivered the manipulation of the type and amount of alcohol consumed by the female target was presented on a dark blue background with white letters in Ariel size 12 font.

RESULTS

Ratings of Intoxication. Oneway ANOVAs were conducted on ratings of how intoxicated the female target was at the end of the party. Results indicated that participants rated the female target as being more intoxicated after drinking six alcoholic beverages ($M = 5.79$, $SD = 1.64$) than when she drank two alcoholic beverages ($M = 3.75$, $SD = 1.71$), $F(1, 81) = 30.45$, $p < .001$, partial $\eta^2 = .27$. There were no statistically significant results for the type of drink (i.e., beer or margarita-flavored alcopop) consumed by the female target, $F(1, 81) = 2.56$, ns or for participants' gender, $F(1, 81) = .23$, ns .

Attractiveness Findings. A 2 (Gender of Participant) x 2 (Type of Alcoholic Beverage Female Target Consumed: Beer, Margarita-flavored Alcopop) x 2 (Amount Female Target Consumed: Two, Six) analysis of variance (ANOVA) was conducted on the attractiveness index. There was a main effect for the participant's gender, $F(1, 75) = 6.31$, $p = .01$, partial $\eta^2 = .08$, such that men rated the female target as more attractive ($M = 4.55$, $SD = 1.22$) than did women ($M = 3.95$, $SD = .94$). There were no other statistically significant results for this analysis.

Promiscuity Findings. A 2 (Gender of Participant) x 2 (Type of Alcoholic Beverage Female Target Consumed: Beer, Margarita-flavored Alcopop) x 2 (Amount Female Target Consumed: Two, Six) analysis of variance (ANOVA) was conducted on the promiscuity index. There was a marginally significant effect for the amount of alcohol consumed, $F(1, 75) = 3.42$, $p < .07$, partial $\eta^2 = .04$, such that the female target was perceived in more promiscuous terms when she consumed six alcoholic beverages ($M = 3.28$, $SD = 1.02$) than when she consumed two alcoholic beverages ($M = 2.89$, $SD = .80$). The analysis revealed a

three-way interaction for the participant’s gender, type of alcohol beverage consumed and amount consumed $F(1, 75) = 6.71, p = .01, \text{partial } \eta^2 = .08$. Simple effects tests indicated that males and females differed in their perceptions of the female target. The Type of Alcoholic Beverage Consumed x Amount Consumed interaction was significant for women, $F(1, 40) = 8.16, p = .007, \text{partial } \eta^2 = .17$. Further examining women’s rating of the female target, simple effects tests indicate that the female target was perceived to be more promiscuous when she consumed six margarita-flavored alcopops ($M = 3.87, SD = .87$) compared to two margarita-flavored alcopops ($M = 2.60, SD = .74, F(1, 21) = 14.08, p = .001, \text{partial } \eta^2 = .40$).

Behavioral Intention Findings. A 2 (Gender of Participant) x 2 (Type of Alcoholic Beverage Female Target Consumed: Beer, Margarita-flavored Alcopop) x 2 (Amount Female Target Consumed: Two, Six) analysis of variance (ANOVA) was conducted the likelihood that the female target would have sexual intercourse with her date later that night. There was a significant interaction effect between the Type of Alcoholic Beverage Consumed and the Amount Consumed, $F(1, 75) = 3.80, p = .05, \text{partial } \eta^2 = .05$. Simple effects tests indicated that the female target was perceived to be more likely to engage in sexual intercourse with her date later that evening when she consumed six margarita-flavored alcopops ($M = 5.90, SD = 1.12$) compared to two margarita-flavored alcopops ($M = 4.82, SD = 1.79, F(1, 40) = 5.38, p < .03, \text{partial } \eta^2 = .12$).

DISCUSSION

As has been found in prior research (Henningsen, 2004; Fisher and Walters, 2003; Bondurant and Donat, 1999; Johnson, Stockdale, Saal, 1991; Harnish, Abbey and DeBono, 1990; Saal, Johnson, and Weber, 1989; Shotland and Craig, 1988; Abbey, Cozzarrelli, McLaughlin, and Harnish, 1987; Abbey and Melby, 1986; Abbey, 1982), male participants perceived the female target in more sexual terms than did female participants. In addition, the current results suggest that type of alcohol consumed and the amount of alcohol consumed impact males and females’ perceptions of a female target’s sexuality differently. Women perceived the female target to be more promiscuous when she consumed six margarita-flavored alcopops compared to when the female target consumed two margarita-flavored alcopops.

Table 1. Mean Promiscuity Ratings of Female Target

	Male		Female	
	Two Drinks	Six Drinks	Two Drinks	Six Drinks
Beer	3.27 (11)	3.85 (13)	3.58 (12)	3.40 (10)
Margarita Alcopop	3.91 (11)	2.83 (12)	2.38 (13)	4.08 (12)

Note: Responses were made on a 7-point scale where 1 = not at all and 7 = very much.

Why then are women, compared to men, more sensitive to and use alcohol-related cues? Perhaps women are more sensitive to and attend to more alcohol cues because they have experienced unwanted sexual advances in a mixed-gender drinking situations and need to monitor their behavior closely to avoid unwanted advances (Abbey, 1991). Indeed, traditional gender roles suggest that women need to guard against expressions of sexual availability because men are always seeking it (Room, 1996). Nevertheless, it appears gender roles are changing. Recent assessments of binge drinking among college students suggest that women undergraduates are rapidly closing the gap to their male counterparts (Weschler, Lee, Kuo, Seibring, Nelson, and Lee, 2002). Other research suggests that in a dating situation, women may now be feeling the pressure to drink larger quantities of alcohol in the presence men in order to elevate their social status and stand out from their peers (Young et al., 2005). However, the type of alcohol consumed appears to drive the social status effect. Women who were able to consume large quantities of “guy drinks” (e.g., beer) were said to be more sexually appealing by both sexes (Young et al., 2005). Indeed as our results indicate, the female target was rated as more promiscuous by women when the target drank six margarita-flavored alcopops compared to two margaritas. She was not rated as being sexier when consuming larger amounts of the margarita-flavored alcopop. Thus, our participants did not elevate the social status of the female target but debased the social status of the female target.

Why might the female participants engage in a downward comparison? Perhaps women became anxious when viewing a novice drinker (i.e., someone drinking a margarita-flavored alcopop) consuming a large quantity of alcohol in a dating situation because such behavior signaled a loss of sexual restraint. To alleviate the anxiety, female participant may have been experiencing, they engaged in downward comparison rating the female target more negatively (promiscuous) when she drank six margarita-flavored alcopops than when she drank two. Such downward comparison has been found to be a self-protective, self-enhancing strategy (Lockwood, 2002; Davison, Pennebaker and Dickerson, 2000). For example, Gibbons and Gerrard (1991) found that smokers who joined a smoking cessation support group preferred to have members of the support group who characterized their smoking problem as more serious than themselves. As participants smoking problem became less serious, their preference for having worse off support group members decreased. Was the same downward comparison process used by our participants when evaluating the female target when she consumed six margarita-flavored alcopops?

Research examining social cognition and the self posit individuals interpret, distort and ignore information to create positive self-images (see Taylor and Brown, 1988 for a review). One way in which individuals can create positive self-images is through making social comparisons. Indeed, research on social comparisons suggests that such comparisons occur automatically and are “almost inevitable element of social interaction.” (Brickman and Bulman, 1977, p. 150). Although there has been some debate over the target in which an individual will select for comparison (i.e., a superior or inferior individual) (see Wood, 1989 for a review), research indicates that when one’s positive self-perceptions are threatened, one may use downward comparison (i.e., selecting an inferior other) as a means for restoring one’s positive self-regard (Gibbons, 1986; Wills, 1981; Hakmiller, 1966) if the individual can imagine a self like the other. In this case, the other will represent a feared self in which the individual wishes to avoid becoming in the future (Markus and Nurius, 1986).

Markus and Nurius (1986) define a feared self as the self “we are afraid of becoming.” (p. 954). Thus, it is likely that one’s own experiences with and expectancies of alcohol impact

the judgments made about another who is drinking alcohol. Indeed, research on alcohol expectancies has demonstrated that alcohol enhances or facilitates sexual behaviors (see George and Stoner, 2000 for a review). Thus, an individual's beliefs about the effects of alcohol on sexual behaviors may affect one's perception of the consequences of consuming alcohol (Marlatt and Rohsenow, 1980) as well as ratings of one's self and others (George et al., 1995; 1988; Abbey et al., 2005; 2000; Abbey and Harnish, 1995). Indeed, George, Stoner, Norris, Lopez and Lehman (2000) found that participants who had consumed alcohol, even though none was drunk, indicated greater sexual arousal and interest in a previously unknown opposite-sex partner. Research is needed to understand how alcohol expectancies impact social comparisons made by males and females when a female target consumes different types of alcohol in mixed-gender interactions.

AUTHOR NOTE

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REFERENCES

- Abbey, A. (1982). Sex differences in attributions for friendly behavior: Do males misperceive females' friendliness? *Journal of Personality and Social Psychology*, *42*, 830-838.
- Abbey, A. (1991). Acquaintance rape and alcohol consumption on college campuses: How are they linked? *Journal of American College Health*, *39*, 165-169.
- Abbey, A., Cozzarrelli, C., McLaughlin, K., and Harnish, R. J. (1987). The effects of clothing and dyad sex composition on perceptions of sexual intent: Do women and men evaluate these cues differently? *Journal of Applied Social Psychology*, *17*, 108-126.
- Abbey, A., and Harnish, R. J. (1995). Perceptions of sexual intent: The role of gender, alcohol consumption and rape supportive attitudes. *Sex Roles*, *32*, 297-313.
- Abbey, A., and Melby, C. (1986). The effects of nonverbal cues on gender differences in perceptions of sexual intent. *Sex Roles*, *15*, 283-298.
- Abbey, A., Zawacki, T., and Buck, P. O. (2005). The effects of past sexual assault perpetration and alcohol consumption on men's reactions to women's mixed signals. *Journal of Social and Clinical Psychology*, *24*, 129-155.
- Abbey, A., Zawacki, T., and McAuslan, P. (2000). Alcohol's effects on sexual perception. *Journal of Studies on Alcohol*, *61*, 688-697.
- Baron, R. M., and Kenny, D. A. (1986). The moderator-mediator variable distinction in social psychological research: Conceptual, strategic, and statistical considerations. *Journal of Personality and Social Psychology*, *51*, 1173-1182.
- Bondurant, B., and Donat, P. L. N. (1999). Perceptions of women's sexual interest and acquaintance rape: The role of sexual overperception and affective attitudes. *Psychology of Women Quarterly*, *23*, 691-705.

- Brickman, P., and Bulman, R. J. (1977). Pleasure and pain in social comparison. In J. M. Suls and R. L. Miller (Eds.), *Social comparison processes: Theoretical and empirical perspectives* (pp. 149-186). Washington, DC: Hemisphere.
- Cooper, M. L. (2002). Alcohol use and risky sexual behavior among college students and youth. *Journal of Studies on Alcohol, 14*(Suppl.), 101-117.
- Davison, K. P., Pennebaker, J. W., and Dickerson, S. S. (2000). Who talks? The social psychology of illness support groups. *American Psychologist, 55*, 205-217.
- Fisher, T. D., and Walters, A. S. (2003). Variables in addition to gender that help explain differences in perceived sexual interest. *Psychology of Men and Masculinity, 4*, 154-162.
- George, W. H., Cue, K. L., Lopez, P. A., Crowe, L. C., and Norris, J. (1995). Self-report alcohol expectancies and postdrinking sexual inferences about women. *Journal of Applied Social Psychology, 25*, 164-186.
- George, W. H., Gournic, S. J., and McAfee, M. P. (1988). Perceptions of postdrinking female sexuality: Effects of gender, beverage choice, and drink payment. *Journal of Applied Social Psychology, 18*, 1295-1317.
- George, W. H., and Stoner, S. A. (2000). Understanding acute alcohol effects on sexual behavior. *Annual Review of Sex Research, 11*, 92-124.
- George, W. H., Stoner, S. A., Norris, J., Lopez, P. A., and Lehman, G. L. (2000). Alcohol expectancies and sexuality: A self-fulfilling prophecy analysis of dyadic perceptions and behavior. *Journal of Studies on Alcohol, 61*, 168-176.
- Gibbons, F. X. (1986). Social comparison and depression: Company's effect on misery. *Journal of Personality and Social Psychology, 51*, 140-148.
- Gibbons, F. X., and Gerrard, M. (1991). Social comparison and smoking cessation: The role of the "typical smoker." *Journal of Experimental Social Psychology, 27*, 239-258.
- Hakmiller, K. L. (1966). Threat as a determinant of downward comparison. *Journal of Experimental Social Psychology, Supplement, 1*, 32-39.
- Harnish, R. J., Abbey, A., and DeBono, K. G. (1990). Toward an understanding of the "sex game": The effects of gender and self-monitoring on perceptions of sexuality and likeability in initial interactions. *Journal of Applied Social Psychology, 20*, 1333-1344.
- Health Education Authority. (1996). *Young people and alcohol: A survey of attitudes and behaviour towards new types of alcoholic drinks in England. Summary of key findings*. London: Author.
- Henningsen, D. D. (2004). Flirting with meaning: An examination of miscommunication in flirting interactions. *Sex Roles, 50*, 481-489.
- Johnson, C. B., Stockdale, M. S., and Saal, F. E. (1991). Persistence of men's misperceptions of friendly cues across a variety of interpersonal encounters. *Psychology of Women Quarterly, 15*, 463-475.
- Leigh, B. C., and Stall, R. (1993). Substance use and risky sexual behavior for exposure to HIV: Issues in methodology. *American Psychologist, 48*, 1035-1045.
- Lockwood, P. (2002). Could it happen to you? Predicting the impact of downward comparisons on the self. *Journal of Personality and Social Psychology, 82*, 343-358.
- Markus, H., and Nurius, P. (1986). Possible selves. *American Psychologist, 41*, 954-969.
- MediaLab [Computer software]. (2004). New York, NY: Empirisoft Inc.
- Peterson, J. V., Nisenholz, B., and Robinson, G. (2003). *A nation under the influence: America's addition to alcohol*. Boston, MA: Allyn and Bacon.

- Roberts, C., Blakey, V., Tudor-Smith, C. (1999). The impact of “alcopops” on regular drinking by young people in Wales. *Drugs; Education, Prevention and Policy*, 6, 7-15.
- Room, R. (1996). Gender roles and interactions in drinking and drug use. *Journal of Substance Abuse*, 8, 227-239.
- Samson, H. H., Tolliver, G. A., Lumeng, L. and Li, T. K. (1989). Ethanol reinforcement in the alcohol non-preferring rat: Initiation using behavioural techniques without food restriction. *Alcoholism: Clinical and Experimental Research*, 13, 378-385.
- Taylor, S. E., and Brown, J. (1988). Illusion and well-being: A social psychological perspective on mental health. *Psychological Bulletin*, 103, 193-210.
- Wechsler, H., Lee, J. E., Kuo, M., Seibring, M., Nelson, T. F., and Lee, H. (2002). Trends in college binge drinking during a period of increased prevention efforts. Findings from 4 Harvard School of Public Health College Alcohol Study surveys: 1993–2001. *Journal of American College Health*, 50, 203-217.
- Wills, T. A. (1981). Downward comparison principles in social psychology. *Journal of Personality and Social Psychology*, 90, 245-271.
- Wood, J. V. (1989). Theory and research concerning social comparisons of personal attributes. *Psychological Bulletin*, 106, 231-248.
- World Health Organization. (1999). *Global status report on alcohol*. Geneva, Switzerland: Author.
- Young, A. M., Morales, M., McCabe, S. E., Boyd, C. J., and D’Arcy, H. (2005). Drinking like a guy: Frequent binge drinking among undergraduate women. *Substance Use and Misuse*, 40, 241-267.

Short Communication

SOCIAL CAPITAL AND ETHICS: THEIR INFLUENCE ON ECONOMIC PERFORMANCE

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ABSTRACT

Recently, social capital has been considered as a production factor along with physical capital and human capital, that contribute to higher economic growth and also improve economic productivity. Social capital is also considered important for the efficient performance of modern economies and the *sine qua non* of a stable liberal democracy. It constitutes a component culture of societies that has been organized from both informal and formal institutions and legal norms and rationality.

Therefore, social capital is a concept that refers to social networks and reciprocity norms associated with them and are the same as physical capital and human capital, wealth creation, as much individual as collective.

This conception does not imply that the creation of norms generates in itself social capital, but rather these should lead to cooperation between groups and, therefore, they are related with virtues like honesty, commitments maintenance, duties maintenance and reciprocity. From this point their connection is clearly deduced from the socio-economic profitability of the ethics, also, as certain moral behaviour causes an increase in social capital in certain countries that influence positively on their economic growth and on their economic productivity.

This conception of social capital and its economic function, surprise the traditional economic analysis, where the objective of the individuals is to get the maximum possible benefit that can be generated by individualist and egoist morals. So, this paper analyses the essential components of social capital, norms and shared values, reciprocity, trust, honesty, and social networks and their economic effects. After this theoretical analysis, empirical evidence from forty-three countries will be analysed.

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1. INTRODUCTION

An orthodox economy tries to introduce the methodology of natural sciences for the economic behaviour of economic agents, for this reason, ethical aspects have been eliminated, as well as, networks that constitute social capital. These aspects have recently been considered by specialized literature.

The ethical virtues that constitute social capital are considered by Aristotle and classical authors' economic analysis. Later, The Neoclassical School, Marginalist School, Utilitarilist School eliminated ethical values in their economic analysis, as well as, social capital. In spite of the analysis of social capital it did not disappear, but rather was carried out by sociologists.

Recently, the effects of social capital on economic growth and on productivity have been considered unsatisfactory for traditional analyses to explain the economic growth process. For this, the second section will be centred on as certain ethical virtues that contribute to form social capital. Later on, in section three; their economic effects on economic growth will be considered. After that, in section four, an empirical analyse for forty-three countries will be carried out. Finally, it will be closed with some short conclusions.

2. ETHICAL VIRTUES OF SOCIAL CAPITAL

It is possible to find several definitions of the social capital in the literature. In this chapter, the wide definition of social capital of Putnam and Goss (2003, p. 14) was followed, it was understood for social capital that groups of social networks and reciprocity norms associated with them were the same as physical capital and human capital, wealth creation, as much individual as collective (Putnam and Goss, 2003, p. 14).

This definition does not imply that the process of norm creation generates social capital in itself, but rather that these should lead to cooperation among groups and, therefore, they are related with virtues like honesty, maintenance of commitments, fulfilment of duties and reciprocity.

This conception of social capital would be in agreement with that already exposed before by Aristotle (2004) in the *Nichomachean Ethical*. According to Aristotle the form of obtaining "happiness"¹ for most of the people is through "political life"², since it has characteristics of a "happy life"³. Also, some of ethical virtues that Aristotle points out that obtain "happiness" are necessary to the social capital that arises, kindness, sincerity and reciprocity and friendship.

¹ Supreme objective to that all human action is driven.

² According to Aristotle (2004, p. 12) the ways of life are mainly three: the voluptuous life (*bíos apolaustikos*), the political life (*bíos politikós*) and the contemplative life (*bíos theoretikos*). The first one would be like wild sexual pleasures and is characteristic of animals more than people. On the other hand, the political life looks for the obtaining of honours, but its true nature consists of the exercise of virtues in society. Finally, the contemplative life is dedicated to disinterested observation of truth and cultivation of the philosophy and of the science.

³ According to Aristotle (2004) the concept of happiness has two fundamental characteristics: supreme objectivity (because it is always looked for in itself and never for the profit that could bring) and for their self-sufficient character (because he who is happy has enough with what he has and it does not miss anything that is lacking).

So, Aristotle already exposes a great part of the positive effects of social capital when considering friendship. According to Aristotle (2004), friendship is a virtue and, also, it is the most necessary thing in life. Indeed, without friendship nobody would want to live, even if they had other goods; even those that possess wealth, authority or power seem to need, in the main, friends (...). In poverty and in other misfortunes, friends were considered as a refuge. (...). Friendship seems also to maintain cities united, and legislators were interested more in it than justice. Indeed, concord seems to be something similar to friendship and concord in aspired to mainly and, on the other hand, they try mainly to expel discord that causes enmity. And when people are friends, there is no need for justice, but just being fair, if there is a need for friendship, and it seems that those that are fair are also those that are more capable of friendship" (Aristotle, 2004, pp. 215-216).

Therefore, social links, that take place in different types of friendship and ethical virtues associated with them, are those that favour efficient societies and performance an economic activity.

Also, it must be taken into account that social links are also important due to the behaviour norms that sustain them. Networks imply (almost by definition) mutual obligations; they are not interesting as mere "contacts". Commitment networks in a community foment solid reciprocity norms. This means that when members of group or a network are convinced that the others will behave with formality and honesty, trust is born among them. Trust is like a lubricant that makes any group or organization work with more efficiency (Fukuyama, 2001, p. 43).

To understand the importance of social norms the start point is Hobbes' thought. According to Hobbes (2002) people's supreme objective is "happiness" (the same as Aristotle). And in order to obtain it, each individual has unavoidably to be offered the means that lead to it. But contrary to Aristotle (2004), for Hobbes (2002), "the process of reaching happiness never finishes, since for this author happiness is a continuous process in desire; a continuous one that pass from one object to another. To get a thing is only a means to achieve the following one (...)" Also, "the voluntary actions and the inclinations of all people, does not only spread to offer a "happy life", but to assure it" (Hobbes, 2002, p. 109).

Hobbes (2002) indicates that it is this desire that passes from one object to another, that leads to competition among individuals for the acquisition of wealth, honours, dignities, or any sign of power, this fact leads to antagonism, to enmity and war. For these reasons individuals establish social norms.

This competition among individuals and destructive possibilities is what leads individuals to establish coexistence norms and laws. For an agreement among individuals they delegate this function to the State. So, the establishment of formal norms in this case were carried out by means of the state. But this process described by Hobbes (2002), on occasions, could cause the establishment of informal norms and networks of trust that take the place of social capital, that when arise stop this way of reaching common objectives and matters by means of cooperation among individuals and not by means of competition.

Therefore, in function of that shown previously, it is necessary to indicate that an essential element for the existence of social capital is moral values and social norms that are not mere arbitrary limitations of individual freedom, but the previous condition for any cooperation type. By means of social norms, the individuals enlarge their power and capacities, when following cooperative norms that limit their election freedom and they allow them to communicate with other ones and to coordinate their actions. The social virtues, like

honesty, reciprocity and execution of commitments are not valuable only as ethical values but rather they also possess a tangible monetary value and they facilitate the achievement of objectives common to groups that practice them, so, it is necessary to introduce them into economic analysis.

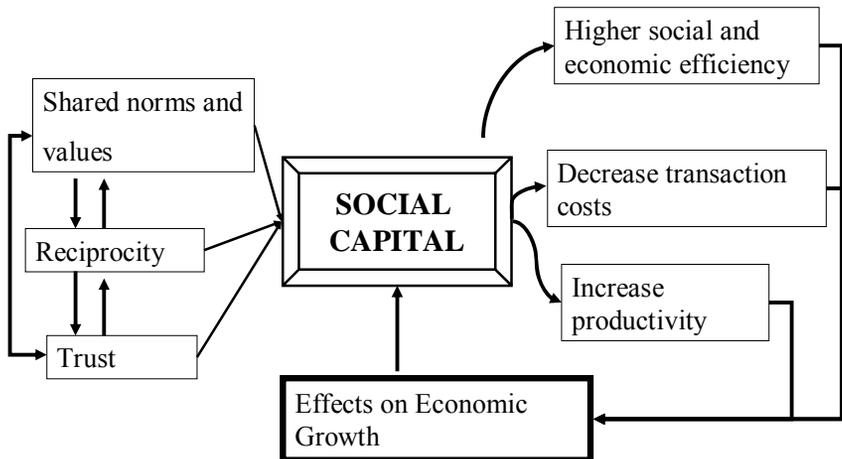
So that a community exists it is not only necessary that people within the group interact, but rather true communities are cohesive because of the values, norms and experiences that their members share. When these common values are deeper and stronger values, community sense are strong and solid (Fukuyama, 2001, pp. 37-42).

As previously indicated, to reach happiness is the supreme objective of human activity. Formal and informal norms are necessary to correct operations in a society that guarantee a framework in which individuals can achieve as many of their individual objectives as collective. This most efficient operation in societies has evident repercussions on economic activity, since economic agents (individuals, families, companies, state) will be able to achieve its economic objectives better.

Figure 1 shows, social norms and ethical virtues that take place in social capital. They have important effects, which will be seen subsequently, in the performance of the economic system, and fundamentally, it has positive effects on economic growth and productivity, when reducing transaction costs and facilitating the transmission of human capital.

However, it is necessary to indicate that not always do types of relationships generate effects which benefit all society, but rather in fact shared norms can cause, on occasions, a certain degree of conflict that is negative for economic activity, like the case of the mafia in Southern Italy and of the Klu Klux Klan in the Northern USA.

Therefore, with inside values and social norms, it is necessary to highlight that those that allow the generating of social capital are those that facilitate the cooperation and include virtues like truth, honesty, execution of obligations and reciprocity.



Source: Castaño (2005) and own elaboration.

Figure 1. Social Capital and Economic Growth.

However, it is necessary to indicate that not always do types of relationships generate effects which benefit all society, but rather in fact shared norms can cause, on occasions, a certain degree of conflict that is negative for economic activity, like the case of the mafia in Southern Italy and of the Klu Klux Klan in the Northern USA.

Therefore, with inside values and social norms, it is necessary to highlight that those that allow the generating of social capital are those that facilitate the cooperation and include virtues like truth, honesty, execution of obligations and reciprocity. Out of all of these, reciprocity has a special interest for this analysis, since it supposes mutual help among individuals that means that trust arises among them and individuals which can unite to obtain common objectives, that is to say, it will form social capital.

So, the fundamental element of social capital is the principle of widespread reciprocity. Therefore, frequent interaction among different people spreads to generate a norm of widespread reciprocity (Portes, 1998; Putnam 1993 and 2002; Uzzi, 1997). These norms of widespread reciprocity solve problems of collective action. This way, it becomes the interest characteristic of individuals and the selfishness of agents with a small obligation sense toward others, that leads to members of a community to try to get shared objectives.

Therefore, a society characterized by widespread reciprocity is more efficient than another distrustful one (Putnam, 2002), since civic commitment and social capital suppose mutual obligation and responsibility to act. As Hanifan recognized (1916) and his successors, social networks and norms of reciprocity can facilitate cooperation for mutual benefit. When economic and political agreements are carried out inside some dense networks of social interaction, opportunism and corruption can reduce their incentives.

Therefore, in the measure that these values and norms appear trust arises. Trust is like a lubricant that makes any group or organization work with more efficiency (Fukuyama, 2001, p. 43 and Alesina and La Ferrara 2000).

3. SOCIAL CAPITAL AND ECONOMIC GROWTH

The economic objective that has been traditionally compared in an economic sense with happiness has been economic growth, therefore, it is necessary to incorporate into the economic analysis the effects of social capital and ethical virtues that they constitute and analyse their effects on economic growth.

Analysing the social capital concept it is possible to consider at least the following sources (Castaño, 2007): (1) family; (2) associations; (3) informal links; (4) links in the work place; and (5) State.

These sources provide trust networks for their members and in fact give rise to trust feelings and reciprocity among their members that give rise to the emergence of social capital. This trust situation produces a more fluent transmission of human capital and facilitates transmission and assimilation of technology, everything that supposes higher economic growth and productivity (Castaño, 2007).

Another positive social capital effect to be considered, is that families and some associations facilitate financial resources to their members in order to create companies (Fukuyama, 2001; Woolcock, 2001 and Woolcock and Narayan, 2000) or to keep them running, in both cases a higher economic growth can be promoted

Besides, social capital reduces by a great amount transaction costs. Therefore, as Gambetta (1988) states, societies that are based on, to greater extents, the use of force seem to be less efficient, more expensive and more unpleasant than those that are based on trust and informal norms. A society where all kinds of agreements among individuals are necessary, a legal norm will incur that causes higher transaction costs that will reduce economic efficiency, and therefore, economic growth.

Therefore, appropriate social capital, where individuals are supported by their families and their environment, together even for a appropriate formal institutional framework, is considered as an element that more than foments economic growth (Galindo, 2003, p.149) and productivity.

So, Hanifan (1916) considers that “social links make our lifes more productive” and that an increment of productivity is achieved by social capital that reduces in great measure transaction costs. Reciprocity and honesty facilitate cooperation and participation, that rebounds in all the agents’ benefit that operate in a socio-economic space (Conill, 2004).

On the other hand, State can influence in the generation of social capital, by means, establishing formal rules that constitute institutional frameworks in a country along with informal norms. So, countries that have some appropriate informal relationships and an adequate legal framework that works well, in some circumstances, can explain a significant part of the reasons why some societies progress quicker than others (Chhibber, 2000).

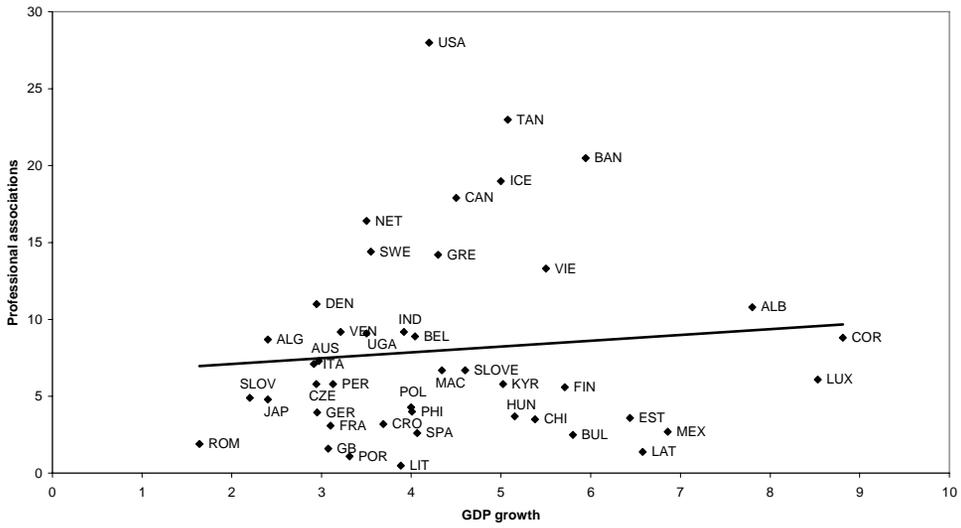
4. EMPIRICAL ANALYSIS

In this section, an empirical analysis has been developed to observe previous theoretical relations. To realise this empirical analysis data has been used from some OECD countries and some developing countries⁴.

To realise this, data has been used from items of the World Value Survey waves and World Bank Indicator for 2000. Then, the sources of social capital previously mentioned are considered and GDP growth, the following figures are obtained.

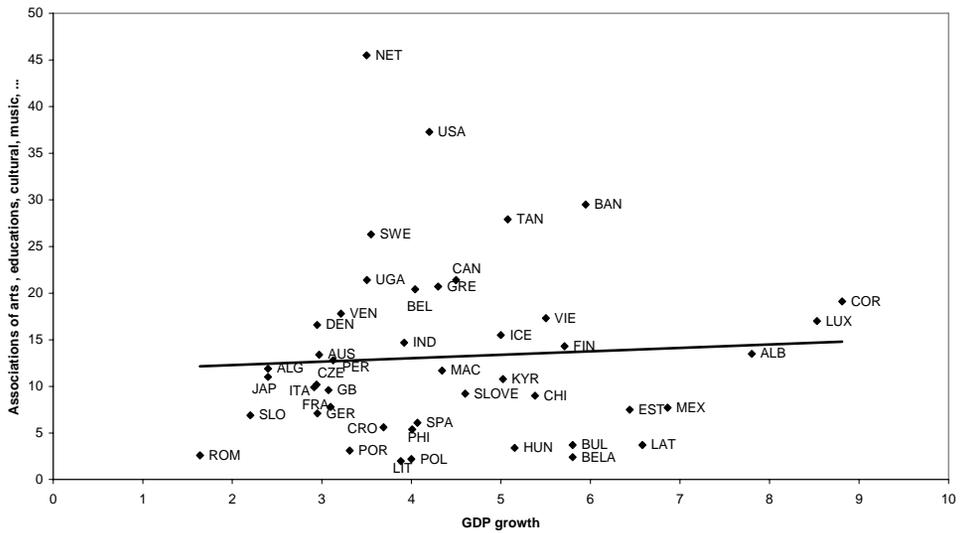
Figure 2 shows a positive relation between those who belong to professional associations and GDP growth. Also, figure 3 shows a positive relation, but in this case, the associations of leisure activities. These results are according with Putnam’s (2002) and Fukuyama’s (2001) thesis.

⁴ Albania (ALB), Algeria (ALG), Austria (AUS), Bangladesh (BAN), Belgium (BEL), Bulgaria (BUL), Belarus (BELA), Canada (CAN), Chile (CHI), Croatia (CRO), Czech Republic (CZE), Denmark (DEN), Estonia (EST), Finland (FIN), France (FRA), Greece (GRE), Hungary (HUN), Iceland (ICE), India (IND), Italy (ITA), Japan (JAP), Republic of Korea (KOR), Kyrgyzstan (KYR), Lithuania (LIT), Luxembourg (LUX), Mexico (Mex), Netherlands (NET), Philippines (PHI), Poland (POL), Portugal (POR), Romania (ROM), Slovakia (SLOV), Viet Nam (VIE), Slovenia (SLOVE), Spain (SPA), Sweden (SWE), Uganda (UGA), Republic of



Source: own elaboration with World Values Survey data and World Bank data.

Figure 2. Associations (I) and Economic Growth.

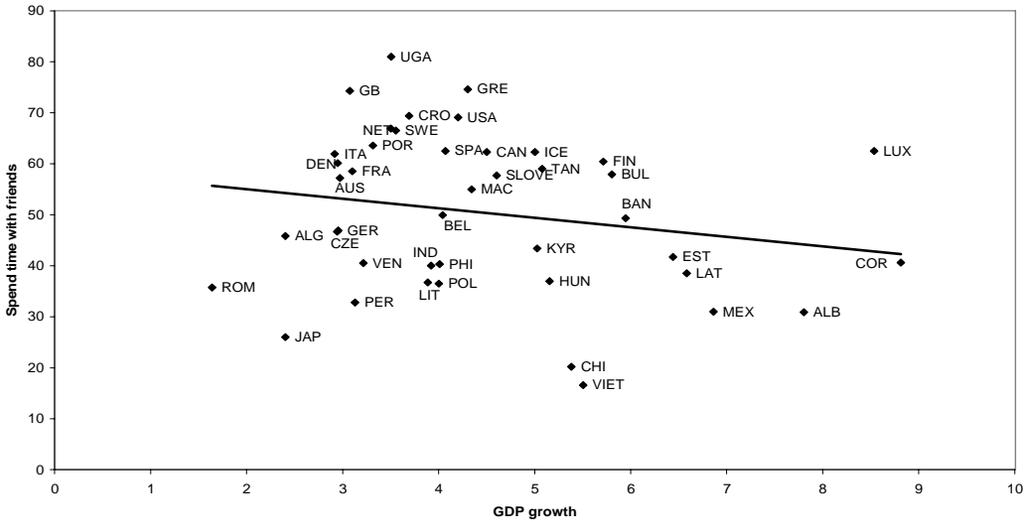


Source: own elaboration with World Values Survey data and World Bank data.

Figure 3. Associations (II) and Economic Growth.

Macedonia (MAC), Great Britain (GB), United Republic of Tanzania (TAN), United States (USA), Venezuela (VEN) and Germany (GER).

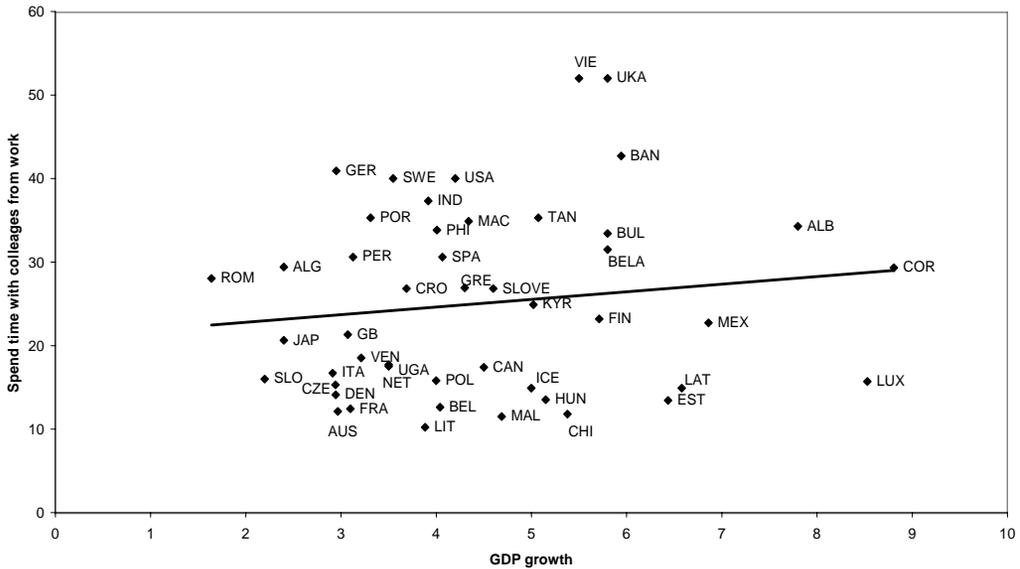
On the other hand, figure 4 shows a negative relation between informal links and economic growth. In this case, this result is not in accordance with theoretical thesis previously mentioned.



Source: own elaboration with World Values Survey data and World Bank data.

Figure 4. Informal Links and Economic Growth.

However, links in the work place measured by means the proxy variable “spend time with work colleagues” has a positive effects on economic growth, this relation was observed by Saxenian, (1994) in Silicon Valley. These positive effects could be explained by links in the work place producing a more fluent transmission of human capital and facilitate transmission and assimilation of technology, everything that supposes higher economic growth and productivity (Castaño, 2007, p. 141).

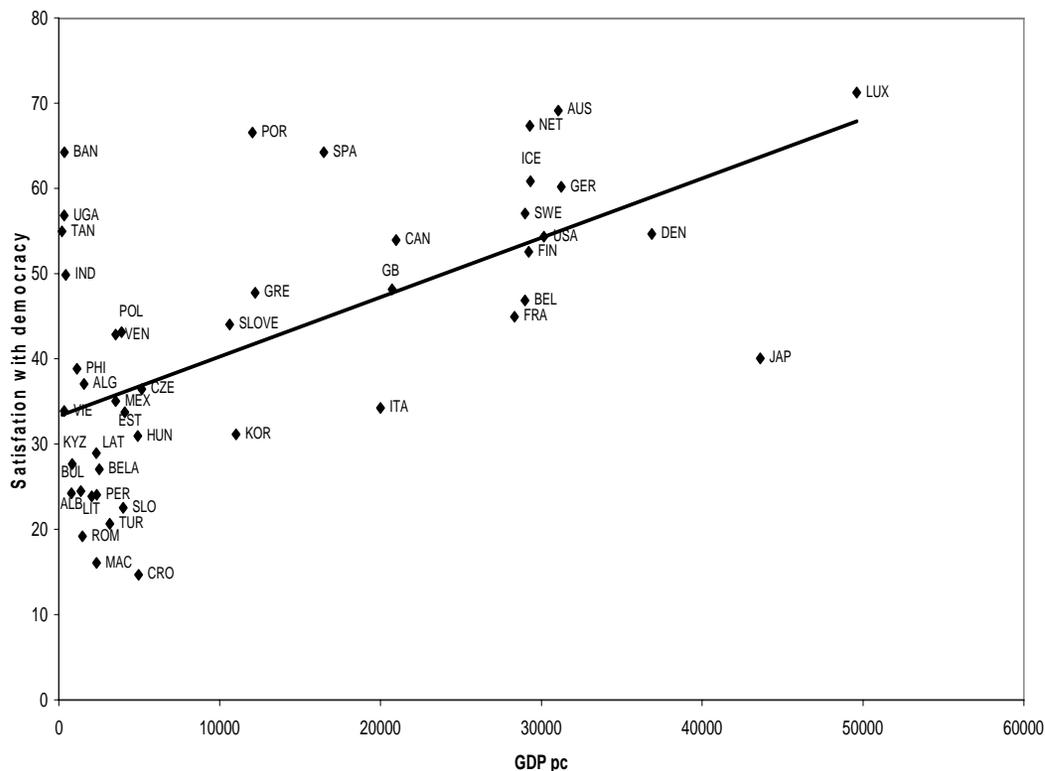


Source: own elaboration with World Values Survey data and World Bank data.

Figure 5. Liks in the Work place and Economic Growth.

According to Putnam (2002) a good patrimony of social capital in a society will improve political democracy and economic outcomes by increasing the capacity of individuals to cooperate for common objectives and to reduce the transaction costs, and it defends a good operating of public institutions depending on, at least partly, social network links. Also, the capacity of social groups to be mobilized by community interests, in fact depends on the quality of formal institutions and where operated (North, 1990).

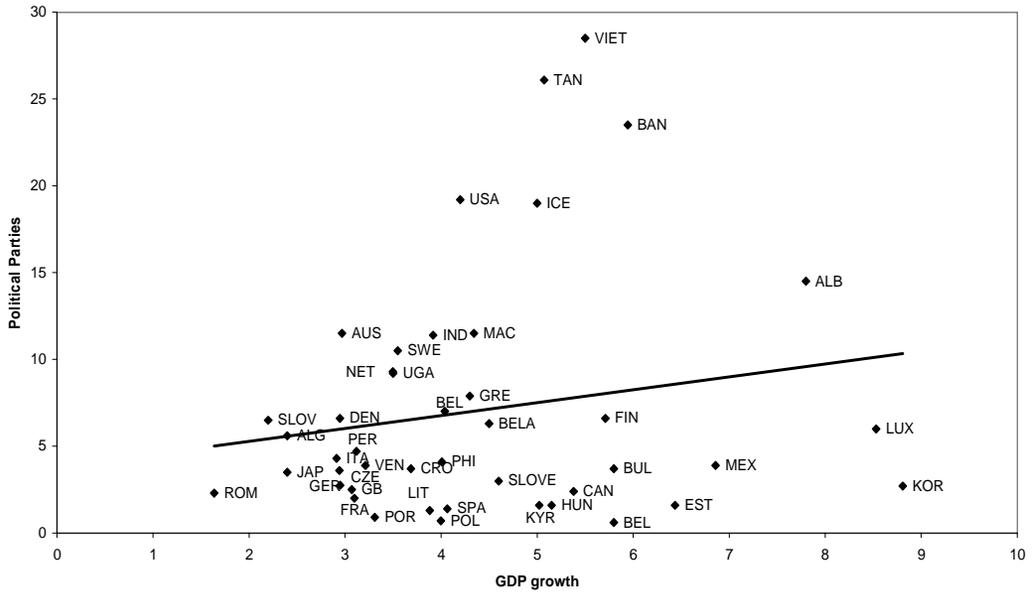
The figures 6, 8 and 9 show these relations. So, figure 6 shows that higher satisfaction with democracy suppose a higher GDP *per capita*.



Source: own elaboration with World Values Survey data and World Bank data.

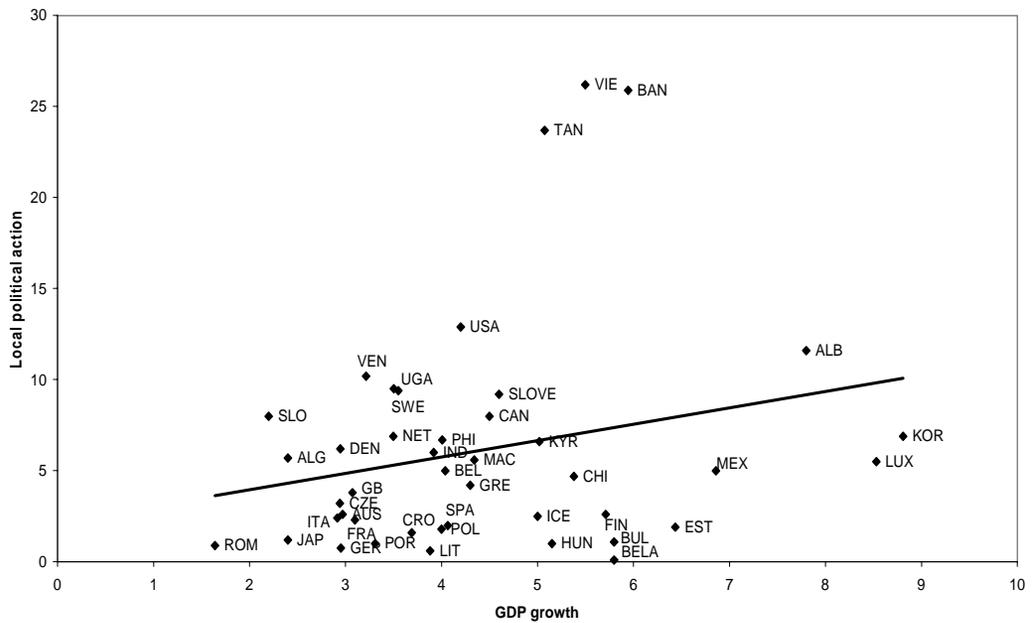
Figure 6. State (I) and Outcome.

Figure 7 shows those who belong to political parties and GDP growth, it is possible to observe a positive relation according with the thesis of Putnam (2002). Also, relations with local political action are considered, it can be observed that this is positive.



Source: own elaboration with World Values Survey data and World Bank data.

Figure 7. State (II) and Economic Growth.



Source: own elaboration with World Values Survey data and World Bank data.

Figure 8. State (III) and Economic Growth.

5. CONCLUSIONS

In this chapter, ethical virtues of social capital that influence economic performance have been exposed. Therefore, although after Smith (2001 and 2004) and before the attempts of some traditional theories of suppressing the economic analysis of the ethical virtues of social capital, as this paper has been able to show, these are essential to the understanding of economical operations and therefore, they must be incorporated in economic analysis.

Also, in this chapter social links, reciprocity norms, trust, and honesty that associate these links or social networks are shown to have an important economic value, not only social and, therefore, social capital can be considered as a new factor that influences economic activity.

Finally, an empirical analyse was carried out that analyses the relations between the sources of social capital and economic growth. So, a positive relation between belonging to associations, links in the work place and state and economic growth can be observed, but, in this case there exists a negative relation with informal links.

6. REFERENCES

- Alesina, A. and La Ferrara, E. (2000). "The determinants of trust"; <http://www.nber.org/papers/w7621>; Documento de trabajo 7621.
- Aristóteles (2004). *Ética Nicomáquea*; Madrid; Gredos y RBA Colecciones.
- Castaño, M.S. (2005). "Los valores éticos del capital social y su influencia en el crecimiento económico", *Información Comercial Española*, June, 2005, pp. 131-140.
- Castaño, M.S. (2007). "The Influence of Socioeconomic Factors on Economic Growth", *International Advances in Economic Research*, pp.139-145.
- Chhibber, A. (2000). "Social Capital, the State and Development Outcomes"; en DASGUPTA, P. AND SERAGELDIN, I. (ed): *Social Capital. A Multifaceted Perspective*; Washington; The World Bank, pp. 296-309.
- Conill, J. (2004), *Horizontes de la economía ética*, Tecnos, Madrid.
- Fukuyama, F. (2001). *La gran ruptura*; Madrid; Punto de Lectura.
- Galindo, M. A. (2003), "Algunas consideraciones sobre el crecimiento económico", *clmeconomía*, nº 2, pp. 129-158, Toledo.
- Gambetta, D. (1988). *Trust: Making and Breaking Cooperative Relations*, Blackwell, Oxford.
- Hanifan, L.J. (1916). "The Rural School Community Center"; *Annals of the American Academy of Political and Social Science*; 67, pp. 130-38.
- Hobbes, T. (2002). *Leviatán I*; Barcelona; RBA Coleccionables.
- North, D.C. (1990). *Institutions, Institutional Change and Economic Performance*; Cambridge (UK), Cambridge University Press.
- Portes, A. (1998). "Social capital: Its origins and applications in modern sociology"; *Annual Review of Sociology*, 24, pp. 1-24.
- Putnam, R.D (2002). *Solo en la Bolera*; Barcelona; Galaxia Gutenberg.
- Putnam, R.D and Goss (2003). "Introducción"; en PUTNAM, R.D (ed): *El declive del capital social*; Barcelona; Galaxia Gutenberg, pp. 7-34.
- Putnam, R.D. (1993). "The Prosperous Community"; *American Prospect*; 13 (Spring); pp. 35-42.

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- Saxenian, A. (1994). *Regional Advantage: Culture and Competition in Silicon Valley and Route 128*, Harvard University Press, Cambridge.
- Smith, A. (2001). *La riqueza de las naciones*, Madrid; Alianza editorial.
- Smith, A. (2004). *La teoría de los sentimientos morales*, Madrid; Alianza editorial.
- Uzzi, B. (1997). "Social structure and competition in interfirm networks: The paradox of embeddedness"; *Administrative Science Quarterly*; 42, pp. 35-67.
- Woolcock, M. (2001). "The place of social capital in understanding economic and social outcomes"; *Canadian Journal of Policy Research*; 2 (1), 11-17.
- Woolcock, M. and Narayan, D. (2000): "Social capital: implications for development theory, research and policy"; *World Bank Research Observer*; 15 (2), 225-249.

Expert Commentary

SOCIAL INTERACTION DEFICITS IN SCHIZOPHRENIA- SPECTRUM DISORDERS AND PHARMACOLOGIC INTERVENTION

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ABSTRACT

Disturbances of social interaction in people suffering from major psychiatric illnesses have attracted concerns from clinicians, researchers, and healthcare administrators, as these deficits are a major determinant of outcome for patients. Impaired social abilities in schizophrenia-spectrum disorders and autism are thought to be partly attributable to specific aspects of symptomatology, such as negative symptoms (blunt affect, social withdrawal, anhedonia) and disturbances of several domains of cognitive function, e.g. verbal memory, working memory, attention/vigilance, and information processing. We recently found that severity of social cognition deficits is correlated with decreased concentrations of essential polyunsaturated fatty acids in the erythrocyte membrane in subjects with schizophrenia.

Psychotropic drugs acting on monoamine receptors, such as serotonin (5-HT)-5HT_{1A}, and 5-HT_{2A} receptors, have been shown to improve social behavior and cognitive function in rodents. For example, 5HT_{1A} agonists enhance social interaction and reduce anxiety in rodents, while the newer class antipsychotic drugs with 5-HT_{2A} antagonist actions, e.g. clozapine, melperone, olanzapine, risperidone, quetiapine, ziprasidone, aripiprazole, and perospirone improve negative symptoms and social cognition.

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Several lines of recent research indicate some neuropeptides, such as arginine-vasopressin (AVP) and oxytocin, regulate social interaction in mammalian species, including humans. We have reported that NC-1900, an AVP analogue and agonist at AVP-V1a receptors, ameliorates social interaction deficits in rats treated with MK-801, an antagonist at N-methyl-D-aspartate (NMDA) receptors. This result from an animal model of schizophrenia is consistent with our earlier observation that chronic administration of the NMDA antagonist phencyclidine reduces the V1a receptor number in some brain regions in rats showing social interaction deficits.

These findings warrant further research into the serotonergic and neuropeptidergic system, or the interaction of the above, to facilitate the development of therapeutic tools to target disturbances of social interaction in patients with schizophrenia or other psychiatric disorders.

I. INTRODUCTION

Disturbances of social interaction in people suffering from major psychiatric illnesses have attracted concerns from clinicians, researchers, and healthcare administrators, as these deficits are a major determinant of outcome for patients (see [1] for review). Impaired social abilities in schizophrenia-spectrum disorders and autism are thought to be partly attributable to specific aspects of symptomatology, such as negative symptoms (blunt affect, social withdrawal, anhedonia) and disturbances of several domains of cognitive function, e.g. verbal memory, working memory, attention/vigilance, and information processing [1-3].

In this chapter, the authors will provide an overview of some of the recent findings regarding the neural substrates for social interaction deficits in schizophrenia, developmental disorders, and related psychiatric disorders. Emphasis will be placed on the possible therapeutic targets for the improvement of social disturbances, e.g. serotonin (5-HT) receptor subtypes and the neuropeptidergic system.

II. SOCIAL INTERACTION DEFICITS IN SCHIZOPHRENIA AND DEVELOPMENTAL DISORDERS

Schizophrenia is a relatively common and often debilitating neuropsychiatric disorder. Its symptoms include positive (e.g., delusions, hallucinations, bizarre thoughts) and negative symptoms, as well as deficits in various cognitive domains as mentioned above. Specifically, minor impairments of social cognition are often observed during the premorbid stage of the illness [4]. Impaired social abilities in schizophrenia-spectrum disorders are thought to be partly attributable to negative symptoms and disturbances of cognitive function [5-7].

Altered composition of phospholipids, a major component of neural membranes, has been suggested to be related to the pathophysiology of schizophrenia [8]. We recently found decreased concentrations of essential polyunsaturated fatty acids (EPUFAs), e.g. eicosapentaenoic acid and docosahexaenoic acid, in the erythrocyte membrane in subjects with schizophrenia, and that the decrease in the EPUFAs levels were positively correlated with severity of verbal social cognition, as evaluated by the script tasks [9,10], in these patients [6].

Impaired social abilities have been also implicated in subjects with developmental disorders, such as autism. Thus, Fries and colleagues (2005) [11] reported decreased urine levels of neuropeptides, arginine vasopressin (AVP) and oxytocin, in children reared in orphanage settings compared to those in infants who received normal care-giving from their parents. Since it has been suggested that previously institutionalized children frequently experience problems in establishing social bonds and regulating social behavior [11], these results provide an excellent addition to the growing evidence for the contribution of the neuropeptidergic systems to social behavior in mammalian species (e.g. [12-14]: see [15] for review). Particularly impressive was the finding that infants who experienced early neglect showed lower basal levels of AVP than family-reared children [11].

These clinical observations in schizophrenia and developmental disorders are consistent with experimental data from our laboratory, suggesting a role for altered AVP activity in social interaction deficits. Thus, Tanaka et al. (2003) observed chronic administration of phencyclidine, an antagonist at N-methyl-D-aspartate (NMDA) receptors, impaired social interaction behavior, and reduced the density of AVP-V1a receptor binding sites in several brain regions, including the lateral septum in rats (Figure 1). Accordingly, Matsuoka et al. (2008) found decreased levels of mRNA encoding AVP in the amygdala, as measured by a microarray system and real-time quantitative PCR assay, in rats chronically treated with MK-801, a non-competitive antagonist at the NMDA receptor (Figure 2). These findings provide a basis for the ability of AVP analogues to ameliorate abnormalities of social interaction in animal models of schizophrenia, as discussed below.

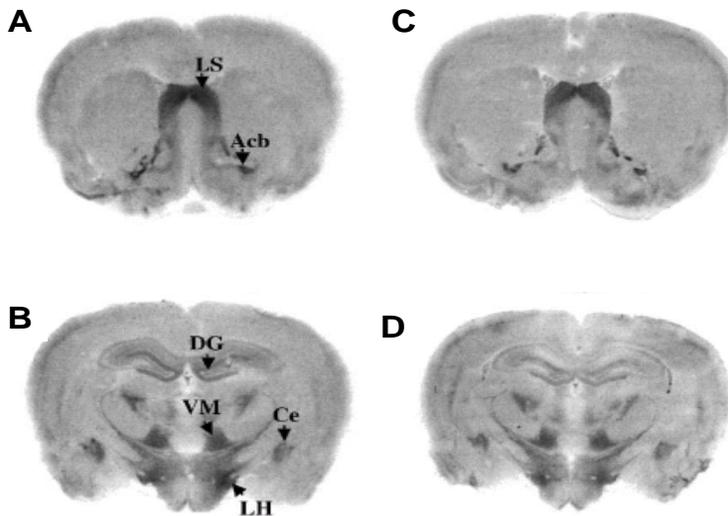


Figure 1. Autoradiographic localization of V1a receptor binding sites in coronal sections of the brain of the vehicle group (A, B) and PCP group (C, D) of rats with [125I]-Linear AVP antagonist. Abbreviations: Acb, nucleus accumbens; LS, lateral septum; Ce, central amygdaloid nucleus; DG, dentate gyrus; VM, ventromedial thalamic nucleus; LH, lateral hypothalamic area.

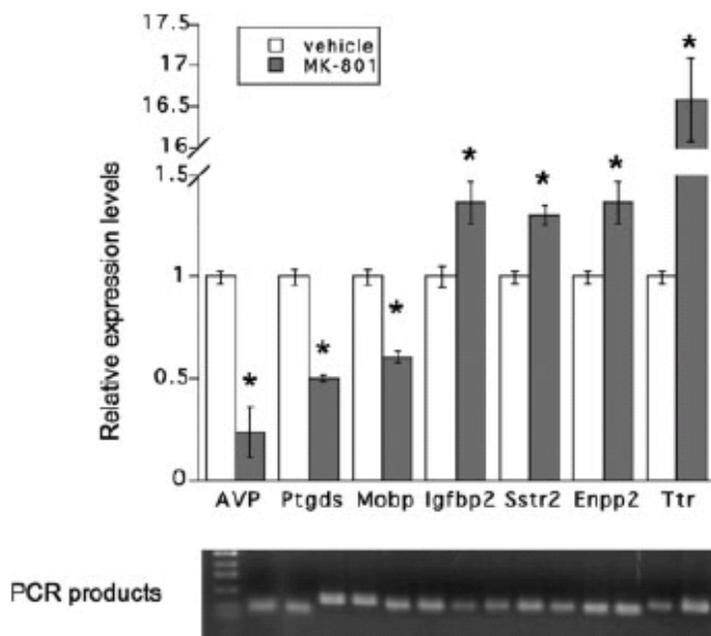


Figure 2. Real-time quantitative PCR data. Each bar represents mean + SD. Values were considered statistically significant when $P < 0.05$ versus Vehicle group.

III. PSYCHOTROPIC/ANTIPSYCHOTIC DRUGS IN THE TREATMENT OF IMPAIRED SOCIAL BEHAVIOR

Although treatment with the first generation antipsychotic drugs, e.g. haloperidol, has been shown to ameliorate positive symptoms, only a limited number of agents, such as the second generation antipsychotics, or so-called “atypical antipsychotic drugs”, e.g. clozapine, melperone, risperidone, olanzapine, quetiapine, ziprasidone, and perospirone have been shown to be partially effective to treat negative symptoms and cognitive disturbances of schizophrenia [7,16-19] (see [20,21] for review).

Specifically, psychotropic drugs acting on monoamine receptors, such as 5-HT_{1A} agonists, have been shown to improve social behavior in animals [19,22,23]. For example, Bubenikova-Valesova et al. (2008) investigated the effect of the 5-HT_{1A} full agonist 8-hydroxy-2-(di-n-propylamino) tetralin (8-OH-DPAT) on social interaction deficits in rats acutely administered MK-801 (0.1 mg/kg), and found low (0.025 mg/kg) but not high (1 mg/day) dose 8-OH-DPAT improved MK-801-induced disruption of social behavior (Figure 3). These results are consistent with the concept that optimized stimulation of 5-HT_{1A} receptors is required to maximize the treatment benefits with regard to some aspects of cognition and social abilities [23-26].

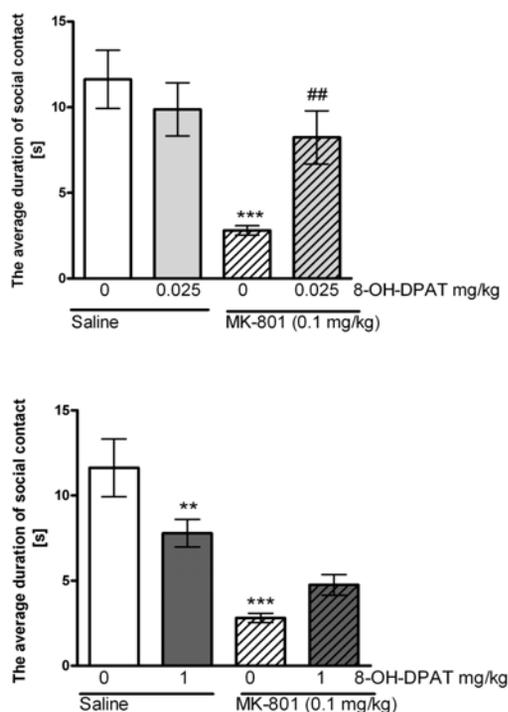


Figure 3. (*Upper figure*) Effect of low dose 5-HT_{1A} receptor agonist (8-OH-DPAT, 0.025 mg/kg) on social interaction. The number of animals in each group was 16. Two-way ANOVA shows main effect of MK-801 [$F_{1,60}=14.1$; $p<0.001$] and interaction between low dose 8-OH-DPAT and MK-801 [$F_{1,60}=6.7$; $p<0.05$]. Newman-Keuls test shows acute administration of MK-801 (0.1 mg/kg) decreased social contact ($***p<0.001$). Acute application of low dose 8-OH-DPAT blocked the effect of MK-801 on social interaction ($## p<0.01$). (*Lower figure*) Effect of high dose 5-HT_{1A} receptor agonist (8-OH-DPAT, 1.0 mg/kg) on social interaction. Two-way ANOVA shows main effect of MK-801 [$F_{1,60}=35.3$; $p<0.001$] and interaction between high dose 8-OH-DPAT and MK-801 [$F_{1,60}=8.4$; $p<0.01$]. Newman-Keuls test shows acute administration of MK-801 (0.1 mg/kg) and high dose 8-OH-DPAT decreased social contact ($**p<0.01$; $***p<0.001$).

IV. THE NEUROPEPTIDERGIC SYSTEM AS A THERAPEUTIC TARGET FOR SOCIAL INTERACTION DEFICITS IN SCHIZOPHRENIA

As discussed above, the AVP system has been indicated as a therapeutic target for social interaction deficits in schizophrenia. Accordingly, we reported that NC-1900, an AVP analogue and agonist at AVP-V1a receptors, ameliorates social interaction deficits in rats chronically treated with MK-801 [13]. This result from an animal model of schizophrenia is consistent with our earlier observation [14] that chronic administration of the NMDA antagonist phencyclidine reduces the density of V1a receptor binding sites in several brain regions, including the lateral septum, in rats showing social interaction deficits. These findings from our laboratory are in concert with Bielsky et al (2005) [12] who reported that re-expressing of V1a receptors in the lateral septum of V1a receptor knockout mice exhibits complete recovery from impaired social recognition. Down-regulation of the AVP gene in the amygdala of MK-801-treated rats may provide a basis for the ability of AVP-analogues to

ameliorate the behavioral disturbances by blockade of NMDA receptor [13]. Oxytocin, another neuropeptide, also has been suggested to play a key role in the regulation of social behavior in mammals, including humans [27-29].

V. CONCLUSION

Although several issues await to be addressed before the neurobiology of social behavior in rodents can be generalized to humans [15], it is reasonable to consider that further research into the serotonergic and neuropeptidergic system, or the interaction of the above, will facilitate the development of therapeutic tools targeting disturbances of social interaction in patients with schizophrenia or other psychiatric disorders.

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REFERENCES

- [1] Sumiyoshi, T., Kawasaki, Y., Suzuki, M., Higuchi, Y., and Kurachi, M. (2008). Neurocognitive assessment and pharmacotherapy towards prevention of schizophrenia: What can we learn from first episode psychosis. *Clin Psychopharmacol Neurosci*, 6, 57-64.
- [2] Kaneda, Y., Sumiyoshi, T., Keefe, R., Ishimoto, Y., Numata, S., and Ohmori, T. (2007). Brief assessment of cognition in schizophrenia: validation of the Japanese version. *Psychiatry Clin Neurosci*, 61, 602-609
- [3] Matsui, M., Sumiyoshi, T., Arai, H., Higuchi, Y., and Kurachi, M. (2008). Cognitive functioning related to quality of life in schizophrenia. *Prog Neuropsychopharmacol Biol Psychiatry*, 32, 280-287.
- [4] Erlenmeyer-Kimling, L., Rock, D., Roberts, S. A. and *et al.* (2000). Attention, memory, and motor skills as childhood predictors of schizophrenia-related psychoses: the New York High-Risk Project. *Am J Psychiatry*, 157, 1416-1422
- [5] Sumiyoshi, C., Sumiyoshi, T., Roy, A., Jayathilake, K., and Meltzer, H. Y. (2006). Atypical antipsychotic drugs and organization of long-term semantic memory: multidimensional scaling and cluster analyses of category fluency performance in schizophrenia. *Int J Neuropsychopharmacol*, 9, 677-683.
- [6] Sumiyoshi, T., Matsui, M., Itoh, H. and *et al.* (2008). Essential polyunsaturated fatty acids and social cognition in schizophrenia. *Psychiatry Res*, 157, 87-93
- [7] Sumiyoshi, T., Higuchi, Y., Ito, T. and *et al.* (in press). Effect of perospirone on P300 electrophysiological activity in schizophrenia: A three-dimensional analysis with sLORETA. *Psychiatry Res Neuroimag*
- [8] Horrobin, D. F. (1998). The membrane phospholipid hypothesis as a biochemical basis for the neurodevelopmental concept of schizophrenia. *Schizophr Res*, 30, 193-208

-
- [9] Chan, A. S., Chiu, H., Lam, L., Pang, A., and Chow, L. Y. (1999). A breakdown of event schemas in patients with schizophrenia: an examination of their script for dining at restaurants. *Psychiatry Res*, 87, 169-181.
- [10] Matsui, M., Sumiyoshi, T., Yuuki, H., Kato, K., and Kurachi, M. (2006). Impairment of event schema in patients with schizophrenia: examination of script for shopping at supermarket. *Psychiatry Res*, 143, 179-187.
- [11] Fries, A. B., Ziegler, T. E., Kurian, J. R., Jacoris, S., and Pollak, S. D. (2005). Early experience in humans is associated with changes in neuropeptides critical for regulating social behavior. *Proc Natl Acad Sci U S A*, 102, 17237-17240
- [12] Bielsky, I. F., Hu, S. B., Ren, X., Terwilliger, E. F., and Young, L. J. (2005). The V1a vasopressin receptor is necessary and sufficient for normal social recognition: a gene replacement study. *Neuron*, 47, 503-513.
- [13] Matsuoka, T., Sumiyoshi, T., Tanaka, K. and *et al.* (2005). NC-1900, an arginine-vasopressin analogue, ameliorates social behavior deficits and hyperlocomotion in MK-801-treated rats: therapeutic implications for schizophrenia. *Brain Res*, 1053, 131-136.
- [14] Tanaka, K., Suzuki, M., Sumiyoshi, T., Murata, M., Tsunoda, M., and Kurachi, M. (2003). Subchronic phencyclidine administration alters central vasopressin receptor binding and social interaction in the rat. *Brain Res*, 992, 239-245
- [15] Storm, E. E., and Tecott, L. H. (2005). Social circuits: peptidergic regulation of mammalian social behavior. *Neuron*, 47(4), 483-486
- [16] McGurk, S. R. (1999). The effect of clozapine on cognitive functioning in schizophrenia. *J. Clin. Psychiatry*, 60 (suppl 12), 24-29.
- [17] Sumiyoshi, T., Jayathilake, K., and Meltzer, H. Y. (2003). The effect of melperone, an atypical antipsychotic drug, on cognitive function in schizophrenia. *Schizophr Res*, 59, 7-16
- [18] Woodward, N. D., Purdon, S. E., Meltzer, H. Y., and Zald, D. H. (2005). A meta-analysis of neuropsychological change to clozapine, olanzapine, quetiapine, and risperidone in schizophrenia. *Int J Neuropsychopharmacol*, 8, 457-472
- [19] Bubenikova-Valesova, V., Votava, M., Palenicek, J., Horacek, J., and Hoschl, C. (2008). Effect of serotonin-1A receptors on behavioral changes in animal model of schizophrenia-like behavior. In: *16th European Congress of Psychiatry*. Nice, France
- [20] Horacek, J., Bubenikova-Valesova, V., Kopecek, M. and *et al.* (2006). Mechanism of action of atypical antipsychotic drugs and the neurobiology of schizophrenia. *CNS Drugs*, 20, 389-409
- [21] Sumiyoshi, T., Kawasaki, Y., Suzuki, M., Higuchi, Y., and Kurachi, M. (2008). Neurocognitive assessment and pharmacotherapy towards prevention of schizophrenia: What can we learn from first episode psychosis? *Clin Psychopharmacol Neurosci*, 6, 57-64
- [22] Snigdha, S., and Neill, J. C. (2008). Improvement of phencyclidine-induced social behaviour deficits in rats: involvement of 5-HT1A receptors. *Behav Brain Res*, 191, 26-31
- [23] Depoortere, R., Auclair, A. L., Bardin, L. and *et al.* (2007). F15063, a compound with D2/D3 antagonist, 5-HT1A agonist and D4 partial agonist properties. III. Activity in models of cognition and negative symptoms. *Br J Pharmacol*, 151, 266-277

- [24] Bruins Slot, L. A., Kleven, M. S., and Newman-Tancredi, A. (2005). Effects of novel antipsychotics with mixed D(2) antagonist/5-HT(1A) agonist properties on PCP-induced social interaction deficits in the rat. *Neuropharmacology*, 49, 996-1006.
- [25] Bubenikova-Valesova, V., Votava, M., Palenicek, T., and Horacek, J. (2007). The opposite effect of a low and a high dose of serotonin-1A agonist on behavior induced by MK-801. *Neuropharmacology* 52, 1071-8.
- [26] Sumiyoshi, T., Higuchi, Y., Matsui, M. and *et al.* (2007). Effective adjunctive use of tandospirone with perospirone for enhancing verbal memory and quality of life in schizophrenia. *Prog Neuropsychopharmacol Biol Psychiatry*, 31, 965-967.
- [27] Lee, P. R., Brady, D. L., Shapiro, R. A., Dorsa, D. M., and Koenig, J. I. (2005). Social interaction deficits caused by chronic phencyclidine administration are reversed by oxytocin. *Neuropsychopharmacology*, 30, 1883-1894
- [28] Lee, P. R., Brady, D. L., Shapiro, R. A., Dorsa, D. M., and Koenig, J. I. (2007). Prenatal stress generates deficits in rat social behavior: Reversal by oxytocin. *Brain Res*, 1156, 152-167
- [29] Jin, D., Liu, H. X., Hirai, H. and *et al.* (2007). CD38 is critical for social behaviour by regulating oxytocin secretion. *Nature*, 446, 41-45.

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